A CATALOGUE OF OIL PROPERTIES

by

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ABSTRACT

This report presents available data on the properties of crude oils and oil products. Oils are arranged in alphabetical order.

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1.0 INTRODUCTION

This catalogue is an extensive compilation of available data on crude oils and petroleum products. Since data from many sources are cited, differences in the reported values may be due to the compositional variance of samples and inherent differences in measurement techniques.

The oils are arranged in alphabetical order.

For each crude oil or oil product, available information on chemical and physical properties, behavioural properties, toxicity and other relevant areas are provided. Equations are reported to describe the effect of temperature and weathering on many properties. Note that these equations are applicable only to the temperature and weathering range of the original data.

An oil's degree of weathering is expressed as the volume or weight percent loss of the original oil sample. Artificial weathering of oil may be performed by gas stripping, where the volume of oil sample is stripped by a stream of compressed air until the desired amount of weathering is achieved (Mackay 1982a, Mackay 1983b).

Where data were not available for some properties, blank spaces were allocated in their places in order to faciliate future updating. Two abbreviations are used in the data sections: N/A (not applicable) and N/M (not measurable).

2.0 DESCRIPTION OF DATA

2.1 Type

The type of crude or oil product is specified and any other relevant information is provided in this section.

2.2 Colour

The observed colour of the oil is provided.

2.3 API Gravity

API gravity is defined as:

$$\text{API Gravity} = \frac{141.5}{\text{Sp. Gr. (60/60 F)}} - 131.5 \qquad (2.1)$$

where Sp. Gr. (60/60 F) is the oil density at 15.6 deg C (60 deg F) divided by the density of water at 15.6 deg C (60 deg F).

2.4 Density

Density is defined as the mass of a unit volume of oil at a specified temperature and has the units g/ml (Speight 1980). The density of crude oils and oil products is dependent on temperature and degree of weathering.

A convenient equation to express density at different temperatures and degrees of weathering (Mackay 1983a) is:

$$DEN = DEN0 + C1\ F - C2\ (T - Ts) \qquad (2.2)$$

where: DEN is density at T and F (g/ml)
DEN0 is density of fresh oil at Ts (g/ml)
C1,C2 are constants
F is fraction of oil weathered
T is temperature of oil (deg C)
Ts is standard temperature (deg C)

2.5 Viscosity

Viscosity is a measure of fluid friction; a fluid's resistance to flow. It is defined as:

$$\text{Dynamic Viscosity} = \frac{\text{Shear Stress}}{\text{Rate of Shear}} \qquad (2.3)$$

The units for dynamic viscosity are mPa.s (or centipoise). Dynamic viscosity is measured by timing the flow of a volume of oil, under gravity, through a capillary at a test temperature (ASTM D 445). For more viscous oils or oils that are non-Newtonian in behavior, viscosity can be measured by a Brookfield viscometer, which rotates a cylinder in the fluid and measures the torque necessary to induce rotation (Perry 1973).

Kinematic viscosity is also widely used:

$$\text{Kinematic Viscosity} = \frac{\text{Dynamic Viscosity}}{\text{Density}} \qquad (2.4)$$

The unit for kinematic viscosity is mm^2/sec (or centistoke).

Viscosity is dependent upon temperature and the degree of weathering (Mackay 1983a) as follows:

$$VISC = VISCO \exp(C3\ F) \exp(C4\ (1/TK - 1/TKs)) \qquad (2.5)$$

where: VISC is viscosity at F and TK (mPa.s)
VISCO is viscosity of fresh oil at TKs (mPa.s)
C3,C4 are constants
F is fraction of oil weathered
TK is temperature of oil (Kelvin, TK = deg C + 273)
TKs is standard temperature (Kelvin)

2.6 Interfacial Tensions

Interfacial tension is the force of attraction between the molecules at the interface of a liquid (Fingas 1979). An indication of both the oil-air and oil-water interfacial tension is essential for calculating spreading rates and the likely extent to which the oil will form oil-in-water and water-in-oil emulsions (Mackay 1983a).

Interfacial tensions are commonly measured by the de Nouy ring technique in which the force required to draw a platinum-iridium ring through the interface is measured (Mackay 1983a, ASTM D 971). The units for interfacial tension are mN/m (or dynes/cm).

The effect of weathering on interfacial tensions (Mackay 1983a) is shown below:

$$SOA = SOA0 + C5\ F \qquad (2.6)$$

where: SOA is oil-air interfacial tension at F (mN/m)
SOA0 is oil-air interfacial tension of fresh oil (mN/m)
C5 is a constant
F is fraction of oil weathered

$$SOW = SOW0 + C6\ F \qquad (2.7)$$

where: SOW is oil-water interfacial tension at F (mN/m)
SOW0 is oil-water interfacial tension of fresh oil (mN/m)
C6 is a constant

2.7 Pour Point

Pour point is the lowest temperature, expressed as a multiple of 3 degree C, at which the oil sample is observed to flow when cooled under prescribed conditions (ASTM D 97). After preliminary heating, the oil sample in a test jar is cooled at a specified rate by immersion into cooling baths kept at different temperatures. The lowest temperature at which movement of oil is observed in the test jar is recorded as the pour point (in degree C).

Pour point as affected by weathering (Mackay 1983a) can be expressed as follows:

$$PP = PP0\ (1 + C7\ F) \qquad (2.8)$$

where: PP is pour point (deg C)
PP0 is pour point of fresh oil (deg C)
C7 is a constant
F is fraction of oil weathered

2.8 Flash Point

Flash point is the lowest temperature, corrected to one atmosphere (101.3 kPa), at which vapours above an oil sample ignite in air when exposed to a flame under specified test conditions. Flash point can be measured by Cleveland Open-cup, Tag Closed and Open-cup, Pensky-Martens Closed, and Setaflash Closed Testers. Generally, the oil sample in the open cup type testers is heated in a open vessel to a selected temperature. A test flame is introduced over the surface of the oil to determine whether the flash point has been reached. If not, the temperature of the oil sample is raised at a specified rate and the process repeated. In closed cup testers, the oil sample is enclosed until a test flame is applied at a specified temperature. If flash point is not reached, the oil sample is covered, the oil temperature is increased at a specified rate and the process is repeated. Loss of volatiles from the oil samples is reduced in this procedure (TSB 1984, ASTM D 92, ASTM D 56, ASTM D 1310, ASTM D 93, ASTM D 3278, Lance 1979).

In the data section, flash points determined by open cup and closed cup type testers are designated by "(O.C.)" and "(C.C.)", respectively. No designation is provided if the testing method is not known.

The effect of weathering on flash point (Mackay 1983a) is:

$$L = L0\ (1 + C8\ F) \qquad (2.9)$$

where: L is flash point at F (deg C)
LO is flash point of fresh oil (deg C)
C8 is a constant
F is fraction of oil weathered

2.9 Vapour Pressure

Vapour pressure is the pressure that an oil exerts on its surroundings. Its units are kPa corrected to one atmosphere (101.3 kPa). Vapour pressure can be measured by Reid, dynamic, static, isoteniscopic, vapour pressure balance and gas saturation methods. In this report, the Reid vapour pressure at 37.8 deg C (100 deg F) is reported. It is measured by saturating a known volume of oil in an air chamber of known volume and measuring the equilibrium pressure which is then corrected to one atmosphere (101.3 kPa) (ASTM D 323, ASTM D 2551, ASTM D 2879, OECO 1981, TSB 1984, USEPA 1982).

2.10 ASTM Distillation

ASTM distillation provides volatility and relative component distribution characteristics of crude oils and oil products. An oil sample is placed in a standard distillation apparatus and heated at a specified rate. Vapour from the oil sample is condensed and collected in graduated cylinders. Vapour and/or liquid temperatures (corrected to one atmosphere or 101.3 kPa) and condensate volumes are recorded. The following definitions are useful:

- Initial boiling point is the temperature at the instant that the first drop of condensate falls from the lower end of the condenser tube.

- End point or final boiling point is the maximum temperature obtained during the test. This usually occurs after the evaporation of all liquid from the bottom of the flask.

- Percent recovered is the volume in millilitres of condensate observed in the receiving graduated cylinder, in connection with a simultaneous thermometer reading.

For better distillate separation of crude oils, a fractionating column can be added (ASTM D 86, ASTM D 285, ASTM E 133).

2.11 Emulsion Formation Tendency and Stability

Water-in-oil emulsion (or "chocolate mousse") is a stable emulsification of small droplets of water incorporated in oil. Oil spilled on a water surface may form stable water-in-oil emulsion which can have very different characteristics than the parent crude oil.

The tendency for a crude oil to form a stable water-in-oil emulsion is measured (Mackay 1982a, Mackay 1984a) as follows:

- Rotate oil and artificial seawater (oil to seawater volume ratio of 1 to 9) in a stoppered Fleaker for one hour at 65 rpm followed by a half hour resting period.
- Measure, visually, fraction of oil that is in the emulsion (f).
- Repeat rotation, resting and measurements three times.
- Obtain f initial by extrapolation.

The following criteria were used to classify the tendency of a crude oil to form stable emulsion (Mackay 1982a):

Range of f initial	Emulsion Formation Tendency
0.0 to 0.25	Not likely
0.25 to 0.75	Fairly likely
0.75 to 1.0	Very likely

The stability of a water-in-oil emulsion is obtained by allowing the emulsion to rest for 24 hours in the stoppered Fleaker in an upright postion, and measuring the fraction of oil in the emulsion (f final) visually. The stability of the water-in-oil emulsion is classified (Mackay 1982a) as follows:

Range of f final	Emulsion Stability
0.0 to 0.25	Unstable
0.25 to 0.75	Fairly stable
0.75 to 1.0	Very stable

The calculated water content of stable water-in-oil emulsions is also provided. The maximum water content for a stable emulsion is 90 percent by volume as specified by the experimental procedure.

2.12 Weathering of Crude Oils

Weathering of crude oils in the environment can be estimated from a modified ASTM distillation experiment. A sample of crude oil is distilled in standard glassware using a hot plate/stirrer. The glassware is insulated and distillate is collected in a graduated cylinder immersed in an ice/water bath. The oil temperature is monitored instead of the temperature of the saturated vapour as in the standard ASTM distillation method. From the gradient and the initial boiling temperature of the distillation curve (a plot of oil temperature versus fraction of oil condensed), the fraction of oil weathered under environmental conditions can be estimated. This estimation method is not very accurate for prolonged weathering of oil spills. At low environmental temperatures, some oils have a tendency to form a surface layer that may reduce the evaporation rate. This estimation method does not apply to refined petroleum products (Mackay 1982a, Mackay 1983b, ASTM D 86).

The calculation procedure is as follows:

(1) Obtain or estimate the following:

- average environment temperature (TK) in Kelvin (Kelvin = deg C + 273)
- volume of the oil spill (V) in cu m,
- area of the oil spill (A) in sq m,
- duration of oil spill (t) in seconds
- average wind speed in m/s,

(2) Calculate mass transfer coefficient (K) in m/s:

$$K = 0.002\ (\text{wind speed})^{0.78} \qquad (2.10)$$

(3) Calculate evaporative exposure (O):

$$O = K\,A\,t\,/\,V \tag{2.11}$$

O can also be calculated if the thickness (in m) of the oil slick can be estimated:

$$O = K\,t\,/\,\text{thickness} \tag{2.12}$$

(4) Calculate fraction (by volume) of oil weathered:

$$Fv = \frac{\ln(1 + 10.3\ TG\ O\ \exp(6.3 - 10.3\ TO/TK)\ /\ TK)}{(10.3\ TG\ /\ TK)} \tag{2.13}$$

where: Fv is fraction of oil weathered by volume
ln is natural log (or take log base 10 and multiply by 2.3)
TO is initial boiling point of modified ASTM distillation curve (Kelvin)
TG is gradient of modified ASTM distillation curve (Kelvin)
exp is exponential base e

2.13 Spreading

The spreading coefficient is an indication of the tendency for crude oils and oil products to spread. The spreading coefficient is defined as:

$$\text{Spreading Coefficient} = SWA - SOA - SOW \quad (2.14)$$

where: SWA is water-air interfacial tension (mN/m)
SOA is oil-air interfacial tension (mN/m)
SOW is oil-water interfacial tension (mN/m)

Spreading to a thin slick will occure if the spreading coefficient of an oil is greater than zero, and the higher the spreading coefficient the faster the spreading will occur.

2.14 Dispersibility

The comparative chemical dispersibility is an indication of the ability to disperse an oil slick chemically in the open sea. The Mackay-Nadeau-Steelman (MNS) apparatus was used. This method simulates wind and wave action in a circular tank, where oil and pre-determined amount of dispersant is added in a reproducable manner. A water sample is taken from a fixed location in the tank and is analyzed for oil content.

In this report, dispersibility tests were conducted at a medium sea state (wind speed of 6 to 14 m/s) and production grade Corexit 9527 was used.

2.15 Fire Point

Fire point is the lowest temperature, corrected to atmospheric pressure (101.3 kPa), that the application of a test flame to the oil sample surface causes the vapour of the oil to ignite and burn for at least five seconds. It is measured by Cleveland Open Cup and modified Pensky-Martens Apparatus. The procedure is similar to the procedure for flash point determination (ASTM D 92, IP 35).

The effect on fire point due to weathering (Mackay 1983a) is:

$$I = I0\ (1 + C9\ F) \qquad (2.15)$$

where: I is fire point at F (deg C)
IO is fire point of fresh oil (deg C)
C9 is a constant
F is fraction of oil weathered

2.16 Solubility

Solubility of crude oils and oil products can be measured by bringing the oil sample to equilibrium with deionized or artificial seawater at a test temperature and analysing the water phase by either gas stripping or liquid extraction. Solubility can be assumed to be independent of temperature and is significantly reduced by weathering (Mackay 1983a) as follows:

$$S = S0\ \exp\ (-C10\ F) \qquad (2.16)$$

where: S is solubility at F (mg/L)
SO is solubility of fresh oil (mg/L)
C10 is a constant
F is fraction of oil weathered

2.17 Paraffin, Olefin, Aromatic, Wax and Asphaltene Content

Paraffins (alkanes) are saturated hydrocarbons that are relatively stable. They do not react with cold fuming sulfuric acid and are not adsorbed on silica gel under specified conditions (Nelson 1958, ASTM 1979).

Olefins (alkenes) are unsaturated straight chain hydrocarbons and are more reactive than paraffins. They react with and dissolve in sulfuric acid (Nelson 1958).

Aromatics are characterized by rings containing 6 carbon atoms. They are considered to be the most toxic hydrocarbons found in oils (Fingas 1979).

Waxes generally consist of long-chain hydrocarbons and probably consist of straight or branched chain paraffins (Nelson 1958, Fingas 1979).

Asphaltenes consist of polynuclear aromatic clusters with relatively small alkane side chains. They are insoluble in alkane solvents such as heptane (Mackay 1984a).

The paraffin, olefin and aromatic content of a crude oil can be determined by high performance liquid chromatography. The wax content can be determined by adding methyl ethyl ketone to the oil sample and chilling the mixture to -10 deg C. Waxes are precipitated and collected by filtration. Asphaltene content is obtained by precipitation and filtration using hexane (Mackay 1982a).

Wax and asphaltene content increases with increasing weathering (Mackay 1983a) as follows:

$$\mathrm{WAX} = \mathrm{WAXO} / (1 - F) \qquad (2.17)$$

where: WAX is wax content at F (mass fraction)
WAXO is wax content of fresh oil (mass fraction)
F is fraction of oil weathered

$$\mathrm{ASPH} = \mathrm{ASPHO} / (1 - F) \qquad (2.18)$$

where: ASPH is asphaltene content at F (mass fraction)
ASPHO is asphaltene content of fresh oil (mass fraction)

2.18 Carbon Residue, Sulphur, Hydrogen Sulphide and Metal Content

Carbon residue is the carbonaceous residue formed after evaporation and pyrolysis of a petroleum product. Carbon residue can be determined by the Conradson or the Ramsbottom methods. The Conradson carbon residue method is more applicable to crude oils and heavy fuel oils. It involves destructive distillation of a weighed oil sample in a crucible. The oil sample is further heated severely for a fixed period of time while the distillation residue undergoes cracking and coking. The Conradson carbon residue is the weight percent of the carbonaceous residue left in the crucible (ASTM D 189, ASTM D 524).

Sulphur content is the weight percent of total sulphur in crude oils or oil products. It can be determined by burning an oil sample in a stream of oxygen at a sufficiently high temperature to convert about 97 percent of the sulphur to sulphur dioxide. The combustion products then flow into an absorber containing an acid solution of potassium iodide and starch indicator. As combustion proceeds, more iodate is added as indicated by the colour of the acid solution. The amount of standard iodate consumed during the combustion is converted to sulphur content of the oil sample (ASTM D 1552).

Hydrogen sulphide content for natural gas and liquefied petroleum gases can be determined by cadmium sulphate-iodometric titration and lead acetate methods, respectively (ASTM D 2385, ASTM D 2420).

The content of many metals in crude oils and oil products can be determined by atomic absorption (ASTM D 2788, Skoog 1976).

2.19 Toxicity

Toxicity values are given as:

- LC50: the estimated concentration of oil which will cause death to 50 percent of the test population in a specified time after exposure.

- LC100: the estimated concentration of oil which will cause death to 100 percent of the test population in a specified time after exposure.

- Median Tolerance Limit (TLm): the concentration at which 50 percent of the test population will show abnormal behaviour.

1.0 TYPE: ADGO CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/mL):

For T between 0 & 15 deg. C:
DEN = 0.959 - 0.00035 T
where: DEN is density of fresh oil at T (g/ml)
T is oil temperature (deg C)

TEMP	WEATHERING			
(DEG C)	0	2.6(vol %)	4(%)	12(%)
0	0.959 (EETD 84)	0.962 (EETD 84)		
15	0.953 (EETD 84)	0.960 (EETD 84)		
20	0.9520 (ESSO 83)		0.9526 (ESSO 83)	0.9546 (ESSO 83)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP		WEATHERING (VOL %)	
(DEG C)	0	2.6	..
0	165.0(EETD 84)	220(EETD 85)	
15	61.6(EETD 84)	73(EETD 85)	

5.2 KINEMATIC VISCOSITY (mm ^{2}/sec or cSt):

TEMP (DEG C)	WEATHERING 0	 2.6(vol %)	 4(%)	 12(%)
-10	661.3 (ESSO 83)		724.5 (ESSO 83)	1302 (ESSO 83)
0	172.1 (ESSO 83) 233.9 (ESSO 83)	228.7 (EETD 85)	263.6 (ESSO 83)	413.8 (ESSO 83)
15	64.6 (ESSO 83) 73.01 (ESSO 83)	76.0 (EETD 85)	79.08 (ESSO 83)	103.2 (ESSO 83)
25	39.83 (ESSO 83)		42.72 (ESSO 83)	53.58 (ESSO 83)

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP (DEG C)	0	WEATHERING (VOL %) 2.6	..
0	33.3(EETD 84)	31.5(EETD 84)	
15	32.0(EETD 84)	30.6(EETD 84)	

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	0	WEATHERING (VOL %) 2.6	..
0	16.8(EETD 85)	16.8(EETD 85)	
15	6.9(EETD 84)	21.5(EETD 85)	

6.3 OIL-WATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	2.6	..
0	25.9(EETD 85)	22.2(EETD 85)	
15	24.9(EETD 84)	22.6(EETD 85)	

7.0 POUR POINT (DEG C):

WEATHERING (%)	POUR POINT (DEG C)
0	-26(ESSO 83)
4	-26(ESSO 83)
12	-26(ESSO 83)

8.0 FLASH POINT (DEG C):

WEATHERING (%)	FLASH POINT (DEG C)
0	95(ESSO 83)
4	94(ESSO 83)
12	126(ESSO 83)

9.0 VAPOUR PRESSURE (kPa): NOT MEASURABLE(EETD 84)

10.0 ASTM DISTILLATION DATA (DEG C):

VOLUME PERCENT	WEATHERING (%) 0	4	12
INITIAL	159(ESSO 83)	170(ESSO 83)	205(ESSO 83)
50	329(ESSO 83)	326(ESSO 83)	348(ESSO 83)
FINAL	535(ESSO 83)	542(ESSO 83)	538(ESSO 83)
FINAL VOL CONT'D.	93 %(ESSO 83)	96 %(ESSO 83)	87 %(ESSO 83)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (VOL %)		
	0	2.6	5.4
0	0.61(EETD 84)	0.72(EETD 84)	
15	0(EETD 85)	1.0(EETD 85)	0(EETD 85)

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (VOL %)		
	0	2.6	5.4
0	0.95(EETD 84)	0.96(EETD 84)	
15	0(EETD 85)	1.0(EETD 85)	0.79(EETD 85)

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (VOL %)		
	0	2.6	5.4
0	71.5(EETD 84)	73.8(EETD 84)	
15	N/A(EETD 85)	77.1(EETD 85)	78.2(EETD 85)

12.0 WEATHERING:

$$Fv = \frac{\ln(1 + 2012.6\ O\ \exp(6.3 - 5675.3/TK)/TK)}{(2012.6/TK)}$$

where: Fv is fraction of oil weathered by volume
ln is natural log
O is evaporation exposure
exp is exponential base e
TK is environmental temperature
(Kelvin, K = deg C + 273) (EETD 84)

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	2.6	..
0	21.1(EETD 85)	22.9(EETD 85)	
15	30.2(EETD 84)	17.1(EETD 85)	

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (DEG C)	WEATHERING (VOL %) 0	2.6
0	92(EETD 85)	88(EETD 85)
15	88(EETD 85)	71(EETD 85)

14.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (DEG C)	WEATHERING (VOL %) 0	2.6
0	62(EETD 85)	<1(EETD 85)
15	23(EETD 85)	10(EETD 85)

15.0 OTHERS:

15.1 FIRE POINT (DEG C):

WEATHERING (%)	FIRE POINT (DEG C)
0	116(ESSO 83)
4	123(ESSO 83)
12	129(ESSO 83)

1.0 TYPE: ALASKA NORTH SLOPE CRUDE OIL (ANS, SUDLEROCHIT).
TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 26.4(AALUND 83)

4.0 DENSITY (g/ml): @ 21 DEG C, 0.8954(AALUND 83)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt): @ 15.6 DEG C, 42.42(AALUND 83)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -17.8(AALUND 83)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa): 24.495(AALUND 83)

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION & TENDENCY:

12.0 WEATHERING:

13.0 SPREADING COEFFEICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 SULFUR (WT %): 1.06(AALUND 83)

15.2 CARBON RESIDUE (WT %): 4.40(AALUND 83)

15.3 METALS (PPM): NICKEL: 11(AALUND 83)
VANADIUM: 26(AALUND 83)

15.4 NITROGEN (PPM): 2,090(AALUND 83)

15.5 H2S (mg/m^3): 25.27(AALUND 83)

15.6 SALT (g/m^3): 2.3606(AALUND 83)

1.0 TYPE: ALBERTA CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml):

TEMP (DEG C)	WEATHERING (WT %) 0	10	20
0	0.850 (MACKAY 82A)		
5	0.846 (MACKAY 82A)		
10	0.843 (MACKAY 82A)		
15	0.840 (MACKAY 82A)		
20	0.835 (MACKAY 82A)	0.855 (MACKAY 82A)	0.866 (MACKAY 82A)
25	0.832 (MACKAY 82A) 0.83 (MACKAY 82A)		

NOTE: DEN = 0.850 - 0.00072T
WHERE: DEN IS THE DENSITY OF FRESH OIL AT T (g/ml)
T IS OIL TEMPERATURE DEG C (MACKAY 82A)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	17.6(MACKAY 82A)		
5	12.4(MACKAY 82A)		
10	9.03(MACKAY 82A)		
15	6.43(MACKAY 82A)		
20	4.98(MACKAY 82A)		
25	4.22(MACKAY 82A)		

NOTE: VISC = EXP((4760/(T+273)) - 14.6)
WHERE: VISC IS VISCOSITY OF FRESH OIL AT T (mPa.s)
T IS OIL TEMPERATURE (DEG C) (MACKAY 82A)

5.2 KINEMATIC VISCOSITY (mm ^{2}/sec or cSt):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	20.7(MACKAY 82A)		
5	14.7(MACKAY 82A)		
10	10.71(MACKAY 82A)		
15	7.65(MACKAY 82A)		
20	5.96(MACKAY 82A)		
25	5.08(MACKAY 82A)		

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C):

WEATHERING (WT %)	POUR POINT (DEG C)
0	-24(MACKAY 82A)
10	12(MACKAY 82A)
20	15(MACKAY 82A)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

TEMP (DEG C)	VAPOUR PRESSURE (kPa)
63	35.7(MACKAY 74)
15.6	66.9(MACKAY 74)

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)
10	120(MACKAY 74)
25	187(MACKAY 74)
40	254(MACKAY 74)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 PARAFFINS (WT %):

WEATHERING (WT %)	PARAFFINS (WT %)
0	78.3(MACKAY 82A)
10	80.3(MACKAY 82A)
20	77(MACKAY 82A)

15.2 AROMATICS (WT %):

WEATHERING (WT %)	AROMATICS (WT %)
0	17.3(MACKAY 82A)
10	13.0(MACKAY 82A)
20	15.2(MACKAY 82A)

15.3 ASPHALTENES (WT %):

WEATHERING (WT %)	ASPHALTENES (WT %)
0	1.21(MACKAY 82A)
10	3.69(MACKAY 82A)
20	4.12(MACKAY 82A)

1.0 TYPE: ALBERTA SWEET MIXED BLEND CRUDE OIL.
EPS STANDARD OIL FOR DISPERSANT TESTING.
TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml):

For Fv below 25.5 % and T between 0 and 15 deg C:
DEN = 0.8475 + 0.00168 Fv - 0.0004 T
where: DEN is density of oil at T and Fv (g/ml)
Fv is volume fraction of oil weathered
T is oil temperature (deg C)

TEMP (DEG C)	WEATHERING (VOL %) 0	14.8	25.5
0	0.847(EETD 84)	0.874(EETD 84)	0.888(EETD 84)
15	0.839(EETD 84)	0.868(EETD 84)	0.883(EETD 84)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (VOL %) 0	14.8	25.5
0	47.3(EETD 85)	7500(EETD 85)	>10000(EETD 85)
15	9.2(EETD 85)	43.5(EETD 85)	48(EETD 85)

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (VOL %) 0	14.8	25.5
0	55.9(EETD 85)	8581(EETD 85)	>11000(EETD 85)
15	11(EETD 84)	50.1(EETD 85)	54.4(EETD 85)

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	14.8	25.5
0	32.0(EETD 85)	N/M(EETD 84)	N/M(EETD 84)
15	25.6(EETD 84)	28.1(EETD 84)	29.4(EETD 84)

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	14.8	25.5
0	17.5(EETD 85)	N/M(EETD 84)	N/M(EETD 84)
15	8.4(EETD 84)	8.6(EETD 84)	15.5(EETD 84)

6.3 OIL-WATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	14.8	25.5
0	30.3(EETD 85)	N/M(EETD 85)	N/M(EETD 85)
15	21.5(EETD 84)	23.8(EETD 84)	21.1(EETD 84)

7.0 POUR POINT (DEG C):

WEATHERING (VOL %)	POUR POINT (DEG C)
0	-8(EETD 85)
14.8	7(EETD 85)

8.0 FLASH POINT (DEG C): 7(C.C.)(EETD 84)

9.0 VAPOUR PRESSURE (kPa): 18.6(EETD 84)

10.0 ASTM DISTILLATION DATA (DEG C):

	WEATHERING (VOL %)			
	0		15.0	
VOLUME PERCENT	MODIFIED ASTM DISTIL'N	ASTM DISTIL'N	MODIFIED ASTM DISTIL'N	ASTM DISTIL'N
IBP	115	37	171	45
5	158	95	213	125
10	182	111	235	148
15	206	126	256	163
20	234	142	276	170
25	260	155	296	183
30	286	198	(MODIFIED ASTM D 86) (EETD 85)	(ASTM D 86) (EETD 85)
34	304	213		
	(MODIFIED ASTM D 86) (EETD 85)	(ASTM D 86) (EETD 85)		

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (VOL %) 0	14.8	25.5
0	1.0(EETD 84)	1.0(EETD 84)	1.0(EETD 84)
15	0(EETD 84)	0(EETD 84)	1.0(EETD 84)

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (VOL %) 0	14.8	25.5
0	1.0(EETD 84)	1.0(EETD 84)	1.0(EETD 84)
15	0.2(EETD 84)	0.2(EETD 84)	1.0(EETD 84)

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (VOL %) 0	14.8	25.5
0	46.7(EETD 84)	90.0(EETD 84)	88.9(EETD 84)
15	N/A(EETD 84)	N/A(EETD 84)	90.0(EETD 84)

12.0 WEATHERING:

$$Fv = \frac{\ln(1 + 3839.8\ O\ \exp(6.3 - 5096.4/TK)/TK)}{(3839.8/TK)}$$

where: Fv is fraction of oil weathered by volume
ln is natural log
O is evaporation exposure
exp is exponential base e
TK is environmental temperature
(Kelvin, K = deg C + 273)

(EETD 84)

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	14.8	25.5
0	21.7(EETD 85)	<0(EETD 84)	<0(EETD 84)
15	35.2(EETD 84)	32.5(EETD 84)	24.3(EETD 84)

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILITY (% DISPERSED):

OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (DEG C)	WEATHERING (VOL %) 0	14.8	25.5
0	73(EETD 85)	36(EETD 85)	76(EETD 85)
15	98(EETD 85)	73(EETD 85)	87(EETD 85)

14.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (DEG C)	WEATHERING (VOL %) 0	14.8	25.5
0	7(EETD 85)	1(EETD 85)	0(EETD 85)
15	19(EETD 85)	11(EETD 85)	10(EETD 85)

15.0 OTHERS:

1.0 TYPE: AMAULIGAK CRUDE OIL. RESULTS FROM EETD 1985 WERE OBTAINED FROM A SAMPLE PROVIDED BY GULF CANADA IN 1985.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/mL):

For Fv < 19.4 % & T between 0 and 15 deg. C:
DEN = 0.900496 + 0.000717 Fv - 0.000698 T
where: DEN is density of oil at T and Fv (g/mL)
Fv is volume percent of oil weathered
T is oil temperature (deg C)

TEMP (DEG C)	WEATHERING (VOL %) 0	13.4	19.4
0	0.9014(EETD 85)	0.9090(EETD 85)	0.9146(EETD 85)
15	0.8896(EETD 85)	0.8992(EETD 85)	0.9048(EETD 85)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (VOL %) 0	13.4	19.4
0	25.0(EETD 85)	41.9(EETD 85)	67.5(EETD 85)
15	14.0(EETD 85)	21.0(EETD 85)	32.2(EETD 85)

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (VOL %) 0	13.4	19.4
0	27.7(EETD 85)	46.1(EETD 85)	73.8(EETD 85)
15	15.7(EETD 85)	23.4(EETD 85)	35.6(EETD 85)

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	13.4	19.4
0	30.0(EETD 85)	31.1(EETD 85)	31.3(EETD 85)
15	29.2(EETD 85)	29.0(EETD 85)	28.5(EETD 85)

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	13.4	19.4
0	21.1(EETD 85)	19.7(EETD 85)	17.8(EETD 85)
15	20.9(EETD 85)	15.0(EETD 85)	15.1(EETD 85)

6.3 OIL-WATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	13.4	19.4
0	27.5(EETD 85)	21.6(EETD 85)	20.8(EETD 85)
15	21.5(EETD 85)	20.4(EETD 85)	19.6(EETD 85)

7.0 POUR POINT (DEG C):

WEATHERING (WT %)	POUR POINT (DEG C)
0	<-25(EETD 85)

8.0 FLASH POINT (DEG C): 0 (C.C.)(EETD 85)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)	
	MODIFIED ASTM DISTILLATION:	ASTM DISTILLATION:
IBP	198	66
5	216	134
10	238	156
15	259	172
20	275	187
25	289	194
29	301	246
	(MODIFIED ASTM D 86) (EETD 85)	(ASTM D 86) (EETD 85)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (VOL %) 0	13.4	19.4
0	0(EETD 85)	0(EETD 85)	1.0(EETD 85)
15	0(EETD 85)	0(EETD 85)	0(EETD 85)

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (VOL %) 0	13.4	19.4
0	0.29(EETD 85)	0.13(EETD 85)	0.78(EETD 85)
15	0(EETD 85)	0(EETD 85)	0(EETD 85)

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (VOL %) 0	13.4	19.4
0	91.3(EETD 85)	92.0(EETD 85)	78.8(EETD 85)
15	N/A(EETD 85)	N/A(EETD 85)	N/A(EETD 85)

12.0 WEATHERING:

$$Fv = \frac{\ln(1 + 3811\ O\ \exp(6.3 - 4851/TK)/TK)}{(3811/TK)}$$

where: Fv is fraction of oil weathered by volume
ln is natural log
O is evaporation exposure
exp is exponential base e
TK is environmental temperature
(Kelvin, K = deg C + 273)
(EETD 85)

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %)		
	0	13.4	19.4
0	20.1(EETD 85)	20.4(EETD 85)	22.1(EETD 85)
15	19.1(EETD 85)	25.2(EETD 85)	25.6(EETD 85)

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILITY (% DISPERSED)

OIL TO DISPERSANT RATIO : 20 TO 1

TEMP (DEG C)	WEATHERING (VOL %)		
	0	13.4	19.4
0	93(EETD 85)	84(EETD 85)	74(EETD 85)
15	71(EETD 85)	65(EETD 85)	68(EETD 85)

14.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (DEG C)	WEATHERING (VOL %)		
	0	13.4	19.4
0	50(EETD 85)	13(EETD 85)	22(EETD 85)
15	14(EETD 85)	28(EETD 85)	6(EETD 85)

15.0 OTHERS:

1.0 TYPE: ARABIAN CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 32.5(API 81)

4.0 DENSITY (g/ml): @ 15.6 DEG C, 0.862(API 81)

5.0 VISCOSITY:

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C):

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)
IBP	29(API 81)
5	69(API 81)
10	100(API 81)
15	128(API 81)
20	151(API 81)
25	172(API 81)
30	198(API 81)
35	213(API 81)
40	238(API 81)
45	261(API 81)
50	282(API 81)
55	304(API 81)
60	329(API 81)
65	351(API 81)
70	373(API 81)
75	398(API 81)
80	422(API 81)
85	448(API 81)
90	475(API 81)
95	504(API 81)
FBP	537(API 81)

NOTE: (API 81) DATA FROM SIMULATED DISTILLATION METHOD ASTM D 2887

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 SULFUR (WT %): 1.87(API 81)

15.2 NITROGEN (WT %): 0.088(API 81)

15.3 METALS (PPM): NICKEL: 14(API 81)
VANADIUM: 3.7(API 81)

1.0 TYPE: ATKINSON CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml):

For F < 12 % & T between 0 and 20 deg. C:
DEN = 0.921788 + 0.001422 F - 0.000689 T
where: DEN is density of oil at T and F (g/mL)
F is percent of oil weathered
T is oil temperature (deg C)

TEMP (DEG C)	WEATHERING (%) 0	4	12
0	0.9219(EETD 85)		
15	0.911(EETD 84)		
20	0.9060(ESSO 83)	0.9172(ESSO 83)	0.9239(ESSO 83)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (%) 0	4	12
-10	304.8(ESSO 83)	762.7(ESSO 83)	2506(ESSO 83)
0	136.2(ESSO 83)	317.0(ESSO83)	783.7(ESSO 83)
15	57.28(ESSO 83)	113.6(ESSO 83)	245.0(ESSO 83)
25	34.94(ESSO 83)	62.05(ESSO 83)	124.4(ESSO 83)

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	30.5(EETD 85)		
15	28.8(EETD 85)		

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	18.7(EETD 85)		
15	17.9(EETD 85)		

6.3 OIL-WATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	24.2(EETD 85)		
15	23.2(EETD 85)		

7.0 POUR POINT (DEG C):

WEATHERING (%)	POUR POINT (DEG C)
0	-38(ESSO 83)
4	-35(ESSO 83)
12	-28(ESSO 83)

8.0 FLASH POINT (DEG C):

WEATHERING (%)	FLASH POINT (DEG C)
0	10(ESSO 83)
4	32(ESSO 83)
12	75(ESSO 83)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA (DEG C):

VOLUME PERCENT	TEMP (DEG C) MODIFIED ASTM DISTILLATION:	ASTM DISTILLATION:
IBP	173	58
5	210	106
10	252	123
15	290	129
17	304	201
	(MODIFIED ASTM D 86) (EETD 85)	(ASTM D 86) (EETD 85)

PERCENT CONDENSED (VOL %)	WEATHERING (%) 0	4	12
INITIAL	40(ESSO 83)	88(ESSO 83)	131(ESSO 83)
50	372(ESSO 83)	383(ESSO 83)	404(ESSO 83)
FINAL	555(ESSO 83)	553(ESSO 83)	556(ESSO 83)
FINAL VOL CONT'D	81 %(ESSO 83)	79 %(ESSO 83)	77 %(ESSO 83)

11.0 EMULSION FORMATION & TENDENCY:

12.0 WEATHERING:

$$Fv = \frac{\ln(1 + 8039\ O\ \exp(6.3 - 4591/TK)/TK)}{(8039/TK)}$$

where: Fv is fraction of oil weathered by volume
ln is natural log
O is evaporation exposure
exp is exponential base e
TK is environmental temperature
(Kelvin, K = deg C + 273)

(EETD 85)

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	22.0(EETD 85)		
15	22.5(EETD 85)		

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 FIRE POINT:

WEATHERING (%)	FIRE POINT (DEG C)
0	26(ESSO 83)
4	50.5(ESSO 83)
12	95(ESSO 83)

1.0 TYPE: AUK CRUDE OIL SHELL/ESSO. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 37.5(HMSO 76)

4.0 DENSITY (g/ml): @ 15 DEG C, 0.837(HMSO 76)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm ^{2}/sec or cSt): @ 15 DEG C, 3.65(HMSO 76)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -1 (-10)(HMSO 76)
NOTE: FIGURES IN BRACKETS ARE OBTAINED FROM THE OIL INDUSTRY AND ARE THOSE WHICH DO NOT AGREE WITH THE PUBLISHED DATA. (HMSO 76)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

WEIGHT PERCENT	TEMP (DEG C)
9.5	5 TO 100(HMSO 76)
10.6	100 TO 160(HMSO 76)
16.6	160 TO 250(HMSO 76)
18.8	250 TO 350(HMSO 76)
44.5	>350(HMSO 76)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILTY:

15.0 OTHERS:

15.1 SULFUR (WT %): 0.4(HMSO 76)

15.2 WAX (WT %): 7(HMSO 76)

1.0 TYPE: AUTOMOTIVE DIESEL. DATA FROM REFERENCE (EETD 85) ARE BASED ON AUTOMOTIVE DIESEL PURCHASED FROM A GAS STATION IN THE SUMMER OF 1984.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml):

	WEATHERING (%)		
TEMP (DEG C)	0	..	..
0	0.838(EETD 84)		
15	0.827(EETD 84)		

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

	WEATHERING (%)		
TEMP (DEG C)	0	..	..
0	3.9(EETD 85)		
15	2.7(EETD 85)		

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

	WEATHERING (%)		
TEMP (DEG C)	0	..	..
0	27.7(EETD 84)		
15	26.0(EETD 84)		

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	28.2(EETD 85)		
15	28.0(EETD 85)		

6.2 OIL-WATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	30.1(EETD 85)		
15	29.4(EETD 85)		

7.0 POUR POINT (DEG C): -20(FINGAS 79)

8.0 FLASH POINT (DEG C): 55(FINGAS 79)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	0 (EETD 85)		
15	0 (EETD 85)		

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	0 (EETD 85)		
15	0 (EETD 85)		

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (%)		
	0	..	..
0	N/A(EETD 85)		
15	N/A(EETD 85)		

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (%)		
	0	..	..
0	15.2(EETD 85)		
15	15.2(EETD 85)		

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILITY (% DISPERSED):

OIL TO DISPERSANT RATIO: 20 TO 1.

TEMP (DEG C)	WEATHERING (%)		
	0	..	..
0	92(EETD 85)		
15	94(EETD 85)		

14.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (DEG C)	WEATHERING (%)		
	0	..	..
0	7(EETD 85)		
15	5(EETD 85)		

15.0 OTHERS:

15.1 INITIAL BOILING POINT (DEG C): 180 TO 360(FINGAS 79)

1.0 TYPE: AUTOMOTIVE GASOLINE (NON-LEADED). TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 60 AT 15 DEG C(FINGAS 79)

4.0 DENSITY (g/ml):

TEMP (DEG C)	0	WEATHERING (%) ..	..
0	0.746(EETD 84)		
15	0.729(EETD 84)		

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	0	WEATHERING (%) ..	..
0	0.75(EETD 85)		
15	0.62(EETD 85)		

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP (DEG C)	0	WEATHERING (%) ..	..
0	20.9(EETD 84)		
15	19.8(EETD 84)		

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	0	WEATHERING (%) ..	..
0	19.8(EETD 84)		
15	18.6(EETD 85)		

6.3 OIL-WATER (mN/m or dynes/cm):

		WEATHERING (%)	
TEMP (DEG C)	0	..	..
0	19.7(EETD 84)		
15	18.0(EETD 84)		

7.0 POUR POINT (DEG C): N/A(FINGAS 79)

8.0 FLASH POINT (DEG C):

WEATHERING (%)	TEMP (DEG C)
0	-43(OHMTADS 81) -40(FINGAS 79)

9.0 VAPOUR PRESSURE (kPa): 62 TO 103(ASTM D 439)

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)
10	50 TO 70(ASTM D 439)
50	77 TO 121(ASTM D 439)
90	195 TO 190(ASTM D 439)
END POINT	225(ASTM D 439)
RESIDUE	2% MAX(ASTM D 439)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

		WEATHERING (%)	
TEMP (DEG C)	0	..	..
0	30.5(EETD 85)		
15	30.8(EETD 85)		

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBLILTY (% DISPERSED):

OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	54(EETD 85)		
15	46(EETD 85)		

14.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	38(EETD 84)		
15	38(EETD 84)		

15.0 OTHERS:

15.1 LEAD CONTENT (g/L): 0.013 MAX(ASTM D 439)

15.2 FLAMMABILITY: QUITE FLAMMABLE, COMBUSTION PROBABLE (OHMTADS 81)

15.3 AUTO-IGNITION TEMPERATURE: 280(OHMTADS 81), 257(CURL 77)

15.4 EXPLOSION LIMITS OF VAPOUR IN AIR:
UPPER: 7.6 PERCENT(CURL 77)
LOWER: 1.4 PERCENT(CURL 77)

15.5 BOILING POINT (DEG C): 38(OHMTADS 81)

15.6 ODOUR THRESHOLD(PPM):
UPPER: 0.01(OHMTADS 81)
LOWER: 0.005(OHMTADS 81)

15.7 INITIAL BOILING POINT (DEG C): 30 TO 200(FINGAS 79)

15.8 SULPHUR (WT %): 0.10 MAX(ASTM D 439)

1.0 TYPE: AVALON CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml):

For Fw < 20.3 % & T between 0 and 25 deg. C:
DEN = 0.8464 + 0.002344 Fw - 0.000478 T
where: DEN is density of oil at T and Fw (g/ml)
Fw is weight percent of oil weathered
T is oil temperature (deg C)

TEMP (DEG C)	WEATHERING (WT %) 0	9.0	20.3
0	0.851(EETD 84) 0.843(MACKAY 82A)	0.867(EETD 84)	0.897(EETD 84)
5	0.841(MACKAY 82A)		
10	0.840(MACKAY 82A)		
15	0.844(EETD 84) 0.839(MACKAY 82A)	0.856(EETD 84)	0.886(EETD 84)
20	0.837(MACKAY 82A)		
25	0.836(MACKAY 82A)		

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (WT %) 0	9.0	20.3
0	575(EETD 84)	>1000(EETD 84)	>5200(EETD 84)
5	148(MACKAY 82A)		
10	72.4(MACKAY 82A)		
15	11.4(EETD 84)	83(EETD 84)	438(EETD 84)
20	33.2(MACKAY 82A)		
25	25.6(MACKAY 82A)		

5.2 KINEMATIC VISCOSITY (mm ^{2}/sec or cSt):

TEMP (DEG C)	WEATHERING (WT %) 0	9.0	20.3
0	675.7(EETD 84)	>1150(EETD 84)	>5780(EETD 84)
5	176(MACKAY 82A)		
10	86.2(MACKAY 82A)		
15	13.5(EETD 84)	97(EETD 84)	94.4(EETD 84)
20	39.7(MACKAY 82A)		
25	30.6(MACKAY 82A)		

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (WT %) 0	9.0	20.3
0	28.0(EETD 84)	28.4(EETD 84)	N/M(EETD 84)
15	26.4(EETD 84)	25.8(EETD 84)	27.9(EETD 84)

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (WT %) 0	9.0	20.3
0	25.2(EETD 84)	33.2(EETD 84)	N/M(EETD 84)
15	20.5(EETD 84)	25.6(EETD 84)	26.7(EETD 84)

6.3 OIL-WATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (WT %) 0	..	..
0	49.4(EETD 85)		
15	29.1(EETD 85)		

7.0 POUR POINT (DEG C):

WEATHERING (WT %)	POUR POINT (DEG C)
0	6(MACKAY 82A)
9.0	21(EETD 84)
20.3	24(EETD 84)

8.0 FLASH POINT (DEG C):

WEATHERING (WT %)	FLASH POINT (DEG C)
0	14(EETD 84)
9	33(EETD 84)
20.3	66(EETD 84)

9.0 VAPOUR PRESSURE (kPa): 63.5(EETD 84)

10.0 ASTM DISTILLATION DATA:

	WEATHERING (VOL %)			
	0		15.5	
VOLUME PERCENT	MODIFIED ASTM DISTIL'N	ASTM DISTIL'N	MODIFIED ASTM DISTIL'N	ASTM DISTIL'N
IBP	146	44	229	122
5	189	95	259	149
10	218	118	289	171
15	248	138	(MODIFIED	(ASTM D 86)
20	279	158	ASTM D 86)	(EETD 85)
25	313	177	(EETD 85)	
	(MODIFIED	(ASTM D 86)		
	ASTM D 86)	(EETD 85)		
	(EETD 85)			

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (WT %) 0	9.0	20.3
0	1.0(EETD 84)	1.0(EETD 84)	0.24(EETD 84)
15	0.16(EETD 84)	0.22(EETD 84)	1.0(EETD 84)

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (WT %) 0	9.0	20.3
0	1.0(EETD 84)	1.0(EETD 84)	1.0(EETD 84)
15	0.37(EETD 84)	0.71(EETD 84)	1.0(EETD 84)

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (WT %) 0	9.0	20.3
0	88(EETD 84)	87(EETD 84)	69(EETD 84)
15	89(EETD 84)	89(EETD 84)	88(EETD 84)

12.0 WEATHERING:

$$Fv = \frac{\ln(1 + 5974\ O\ \exp(6.3 - 4141/TK)/TK)}{(5974/TK)}$$

where: Fv is fraction of oil weathered by volume
ln is natural log
O is evaporation exposure
exp is exponential base e
TK is environmental temperature
(Kelvin, K = deg C + 273)

(EETD 84)

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (WT %) 0	9.0	20.3
0	18.0(EETD 84)	9.6(EETD 84)	<0(EETD 84)
15	22.7(EETD 84)	17.8(EETD 84)	14.6(EETD 84)

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILITY (% DISPERSED):

OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (DEG C)	WEATHERING (VOL %) 0	..
0	20(EETD 85)	
15	40(EETD 85)	

14.1 CHEMICAL DISPERSIBILITY (con't):

OIL TO DISPERSANT RATIO AT 50% DISPERSION

TEMP (DEG C)	WEATHERING (WT %) 0	9.0	20.3
0	<10(EETD 84)	<10(EETD 84)	<10(EETD 84)
15	37(EETD 84)	14(EETD 84)	<10(EETD 84)

14.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (DEG C)	WEATHERING (VOL %) 0	..
0	0(EETD 85)	
15	0(EETD 85)	

15.0 OTHERS:

15.1 SOLUBILITY (mg/L):

	WEATHERING (WT %)		
DISSOLVED IN	0	9.0	20.3
WATER	29.06(ROSS 84)		
SEAWATER	16.92(ROSS 84)	12.1(ROSS 84)	2.36(ROSS 84)

15.2 PARAFFINS (WT %): 79.3(MACKAY 82A)

15.3 AROMATICS (WT %): 14.5(MACKAY 82A)

15.4 WAX (WT %): 8.47(MACKAY 82A)

15.5 ASPHALTENES (WT %): 2.68(MACKAY 82A)

1.0 TYPE: BENT HORN CRUDE OIL. DATA FOR EETD 1985 FROM DRILL STEMP TESTING SAMPLE OF A-02 WELL, 1985.

2.0 COLOUR:

3.0 API GRAVITY: 42(OILWEEK 85)

4.0 DENSITY (g/mL):

For Fv < 32.9% & T between -43 and 18 deg. C:
DEN = 0.829837 + 0.001326 Fv - 0.000627 T
where: DEN is density of oil at T and Fv (g/mL)
Fv is volume percent of oil weathered
T is oil temperature (deg C)

TEMP (DEG C)	WEATHERING (VOL %) 0	20.4	32.9
-43	0.852 (CHARLES 84)		
-15	0.845 (CHARLES 84)		
0	0.8299 (EETD 85) 0.833 (CHARLES 84)	0.8600 (EETD 85)	0.8735 (EETD 85)
15	0.8177 (EETD 85) 0.821 (CHARLES 84)	0.8484 (EETD 85)	0.8615 (EETD 85)
18	0.815 (CHARLES 84)		

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

VISC = EXP (4278 / (T + 273) - 12.32) (CHARLES 84)

where: VISC is dynamic viscosity of fresh oil at T (mPa.s)
T is oil temperature (deg C)
EXP is exponential base e

TEMP (DEG C)	WEATHERING (VOL %) 0	20.4	32.9
-43	44000 (CHARLES 84)		
-30	17430 (CHARLES 84)		
-20	580 (CHARLES 84)		
-10	207 (CHARLES 84)		
0	68 (CHARLES 84) 25.0 (EETD 85)	N/M (EETD 85)	N/M (EETD 85)
15	12.1 (EETD 85)	100 (EETD 85)	525 (EETD 85)

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (VOL %) 0	20.4	32.9
0			
15			

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	20.4	32.9
0	27.4(EETD 85)	31.1(EETD 85)	N/M(EETD 85)
15	25.4(EETD 85)	27.9(EETD 85)	28.7(EETD 85)

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	20.4	32.9
0	34.4(EETD 85)	26.7(EETD 85)	N/M(EETD 85)
15	17.6(EETD 85)	1.7(EETD 85)	2.3(EETD 85)

6.3 OIL-WATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	20.4	32.9
0	30.0(EETD 85)	38.9(EETD 85)	N/M(EETD 85)
15	26.6(EETD 85)	13.8(EETD 85)	11.4(EETD 85)

7.0 POUR POINT (DEG C):

WEATHERING (WT %)	POUR POINT (DEG C)
0	-16(EETD 85) -18 TO 21(OILWEEK 85)
20.4	-2(EETD 85)
32.9	11(EETD 85)

8.0 FLASH POINT (DEG C): -14 (C.C.)(EETD 85)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C) MODIFIED ASTM DISTILLATION:	ASTM DISTILLATION:
IBP	133	33
5	158	92
10	180	113
15	203	130
20	228	149
25	253	169
30	279	188
35	303	206
	(MODIFIED ASTM D 86) (EETD 85)	(ASTM D 86) (EETD 85)

13.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (VOL %) 0	20.4	32.9
0	0(EETD 85)	1.0(EETD 85)	1.0(EETD 85)
15	0(EETD 85)	1.0(EETD 85)	1.0(EETD 85)

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (VOL %) 0	20.4	32.9
0	0(EETD 85)	1.0(EETD 85)	1.0(EETD 85)
15	0(EETD 85)	0.54(EETD 85)	1.0(EETD 85)

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (VOL %) 0	20.4	32.9
0	N/A(EETD 85)	53.8(EETD 85)	77.3(EETD 85)
15	N/A(EETD 85)	47.6(EETD 85)	86.0(EETD 85)

12.0 WEATHERING:

$$Fv = \frac{\ln(1 + 4985\ O \exp(6.3 - 4182/TK)/TK)}{(4985/TK)}$$

where: Fv is fraction of oil weathered by volume
ln is natural log
O is evaporation exposure
exp is exponential base e
TK is environmental temperature
(Kelvin, K = deg C + 273)

(EETD 85)

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	20.4	32.9
0	9.4(EETD 85)	13.4(EETD 85)	<0(EETD 85)
15	26.2(EETD 85)	39.6(EETD 85)	38.2(EETD 85)

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILITY (% DISPERSED):

OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (DEG C)	WEATHERING (VOL %) 0	20.4	32.9
0	86(EETD 85)	12(EETD 85)	<1(EETD 85)
15	69(EETD 85)	81(EETD 85)	69(EETD 85)

14.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (DEG C)	WEATHERING (VOL %) 0	20.4	32.9
0	2(EETD 85)	0(EETD 85)	0(EETD 85)
15	5(EETD 85)	0(EETD 85)	9(EETD 85)

15.0 OTHERS:

15.1 SEPARATOR HYDROCARBON LIQUID ANALYSIS:

COMPONENT	MOLE %
N2	0.16
CO2	0.15
H2S	0.03
C1	7.12
C2	2.75
C3	2.85
iC4	1.30
C4	3.21
iC5	2.28
C5	2.91
C6	5.74
C7	6.00
C8	6.95
C9	5.49
C10	5.49
C11	4.80
C12	3.78
C13	3.98
C14	3.58
C15	2.65
C16	2.24
C17	2.25
C18	1.91
C19	1.53
C20	1.39
C21	1.16
C22	1.08
C23	0.97
C24	0.82
C25	0.79
C26	0.68
C27	0.65
C28	0.63
C29	0.54
C30+	5.83
AROMATICS:	
C6H6	0.08
C7H8	0.29
C8H10	0.74
C8H10	0.91
C9H12	0.45

COMPONENT	MOLE %
NAPTHENES:	
C_5H_{10}	0.36
C_6H_{12}	0.60
C_6H_{12}	0.64
C_7H_{14}	2.14

(PANARTIC 84)

1.0 TYPE: BENT HORN CRUDE OIL.
DATA FOR SAMPLE TAKEN FROM THE
IMPERIAL BEDFORD TANKER ON SEPTEMBER 10, 1985
AT THE PORT OF MONTREAL.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/mL):

For $Fv < 33.3\%$ & T between 0 and 15 deg. C:
$DEN = 0.830471 + 0.001329\ Fv - 0.000784\ T$
where: DEN is density of oil at T and Fv (g/mL)
Fv is volume percent of oil weathered
T is oil temperature (deg C)

TEMP (DEG C)	WEATHERING (VOL %) 0	20.2	33.3
0	0.8298(EETD 85)	0.8589(EETD 85)	0.8738(EETD 85)
15	0.8181(EETD 85)	0.8472(EETD 85)	0.8619(EETD 85)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (VOL %) 0	20.2	33.3
0	53.8(EETD 85)	14750(EETD 85)	110000(EETD 85)
15	24.0(EETD 85)	60.0(EETD 85)	5820(EETD 85)

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (VOL %) 0	20.2	33.3
0			
15			

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	20.2	33.3
0	27.7(EETD 85)	33.1(EETD 85)	N/M(EETD 85)
15	26.2(EETD 85)	28.2(EETD 85)	25.0(EETD 85)

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	20.2	33.3
0	53.5(EETD 85)	32.1(EETD 85)	N/M(EETD 85)
15	38.5(EETD 85)	2.2(EETD 85)	7.4(EETD 85)

6.3 OIL-WATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	20.2	33.3
0	48.0(EETD 85)	42.3(EETD 85)	N/M(EETD 85)
15	39.1(EETD 85)	16.6(EETD 85)	15.4(EETD 85)

7.0 POUR POINT (DEG C):

WEATHERING (WT %)	POUR POINT (DEG C)
0	-18(EETD 85)
20.2	-7(EETD 85)
33.3	8(EETD 85)

8.0 FLASH POINT (DEG C): -9 (C.C)(EETD 85)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C) MODIFIED ASTM DISTILLATION:	ASTM DISTILLATION:
IBP	111	33
5	164	89
10	187	110
15	210	130
20	235	147
25	259	174
30	284	188
34	305	203
	(MODIFIED ASTM D 86) (EETD 85)	(ASTM D 86) (EETD 85)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (VOL %) 0	20.2	33.3
0	0(EETD 85)	1.0(EETD 85)	1.0(EETD 85)
15	0(EETD 85)	1.0(EETD 85)	1.0(EETD 85)

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (VOL %) 0	20.2	33.3
0	0(EETD 85)	1.0(EETD 85)	1.0(EETD 85)
15	0(EETD 85)	1.0(EETD 85)	1.0(EETD 85)

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (VOL %) 0	20.2	33.3
0	N/A(EETD 85)	59.6(EETD 85)	66.0(EETD 85)
15	N/A(EETD 85)	13.6(EETD 85)	44.4(EETD 85)

12.0 WEATHERING:

$$Fv = \frac{\ln(1 + 4944\ O\ \exp(6.3 - 4254/TK)/TK)}{(4944/TK)}$$

where: Fv is fraction of oil weathered by volume
ln is natural log
O is evaporation exposure
exp is exponential base e
TK is environmental temperature
(Kelvin, K = deg C + 273)

(EETD 85)

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	20.2	33.3
0		6.0(EETD 85)	<0(EETD 85)
15	4.5(EETD 85)	38.8(EETD 85)	36.8(EETD 85)

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (DEG C)	WEATHERING (VOL %) 0	20.2	33.3
0	54(EETD 85)	5(EETD 85)	0(EETD 85)
15	60(EETD 85)	63(EETD 85)	5(EETD 85)

14.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (DEG C)	WEATHERING (VOL %) 0	20.2	33.3
0	<1(EETD 85)	0(EETD 85)	0(EETD 85)
15	4(EETD 85)	6(EETD 85)	5(EETD 85)

15.0 OTHERS:

1.0 TYPE: BOW RIVER BLENDED CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 26.7(AALUND 83A)

4.0 DENSITY (g/ml):

	WEATHERING (%)		
TEMP (DEG C)	0	..	..
0	0.900(MACKAY 82A)		
5	0.899(MACKAY 82A)		
10	0.896(MACKAY 82A)		
15	0.893(MACKAY 82A)		
15.5	0.8936(AALUND 83A)		
20	0.889(MACKAY 82A)		
25	0.885(MACKAY 82A)		

NOTES: DEN = 0.901 - 0.000617 T
WHERE: DEN IS THE DENSITY OF FRESH OIL AT T (mPa.s)
T IS OIL TEMPERATURE (DEG C) (MACKAY 82A)

0.923 @ 10 WT% WEATHERING & 0.938 @ 20 WT% WEATHERING(MACKAY 82A)

0.90 @ ROOM TEMP(TWARDUS 80)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	88.4(MACKAY 82A) 74(TWARDUS 80)		
5	62.0(MACKAY 82A)		
10	45.1(MACKAY 82A) 67(TWARDUS 80)		
15	33.7 (MACKAY 82A)		
20	28.3(MACKAY 82A) 42.5(TWARDUS 80)		
25	23.7(MACKAY 82A)		

NOTES: VISC = EXP((4310/(T+273))-11.4)
WHERE: VISC IS VISCOSITY OF FRESH OIL AT T (mPa.s)
T IS TEMP (DEG C) (MACKAY 82A)

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	98.2(MACKAY 82A)		
5	69.0(MACKAY 82A)		
10	50.3(MACKAY 82A)		
15	37.7(MACKAY 82A)		
20	31.8(MACKAY 82A)		
25	26.8(MACKAY 82A)		
40	18.30(AALUND 83A)		

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm): 15 @ ROOM TEMP(TWARDUS 80)

6.2 OIL-SEAWATER (mN/m or dynes/cm): USING 3% NaCl IN TAP WATER: 26.8 ; 23.9 @ 10 WT% WEATHERING & 27.8 @ 20 WT% WEATHERING (MACKAY 82A)

6.3 OIL-WATER (mN/m or dynes/cm): 28.95 @ ROOM TEMP (TWARDUS 80)

7.0 POUR POINT (DEG C):

WEATHERING (WT %)	POUR POINT (DEG C)
0	-39(MACKAY 82A) -27(TWARDUS 80) -50.5(AALUND 83A)
10	-15(MACKAY 82A)
20	-3(MACKAY 82A)

8.0 FLASH POINT (DEG C): <12(O.C.)(TWARDUS 80)

9.0 VAPOUR PRESSURE (kPa): 37.2(AALUND 83A)

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)
0	45.95(TWARDUS 80)
10	115(TWARDUS 80)
20	185(TWARDUS 80)
30	265(TWARDUS 80)
40	310(TWARDUS 80)
50	350(TWARDUS 80)
60	370(TWARDUS 80)
70	385(TWARDUS 80)
80	390(TWARDUS 80)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILTY:

15.0 OTHERS:

15.1 IN-SITU COMBUSTION RESULTS - FRESH OIL IGNITED EASILY, RESIDUE 6.1 VOL% (TWARDUS 80)

15.2 FIRE POINT (DEG C): 22(TWARDUS 80)

15.3 PARAFFINS (WT %):

WEATHERING (WT %)	PARAFFINS (WT %)
0	69.6(MACKAY 82A)
10	66.7(MACKAY 82A)
20	62.5(MACKAY 82A)

15.4 AROMATICS (WT %):

WEATHERING (WT %)	AROMATICS (WT %)
0	21.4(MACKAY 82A)
10	22.4(MACKAY 82A)
20	25.8(MACKAY 82A)

15.5 WAX (WT %):

WEATHERING (WT %)	WAX (WT %)
0	2.75(MACKAY 82A)
10	6.47(MACKAY 82A)
20	8.63(MACKAY 82A)

15.6 ASPHALTENES (WT %):

WEATHERING (WT %)	ASPHALTENES (WT %)
0	5.04(MACKAY 82A)
10	6.47(MACKAY 82A)
20	8.63(MACKAY 82A)

15.7 SULFUR (PPM): 21,000(AALUND 83A)

15.8 CON. CARBON (WT %): 6.7(AALUND 83A)

15.9 METALS (PPM): NICKEL: 20.7(AALUND 83A)
VANADIUM: 54.0(AALUND 83A)

1.0 TYPE: BUNKER C FUEL OIL OR FUEL OIL NUMBER 6. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 14.1(API 81), 10 AT 15 C(FINGAS 79), 7.3(PANCIROV 74), 15.5(YUEN 70)

4.0 DENSITY(g/ml):

For T between 0 and 30 deg C:
DEN = 0.97871 - 0.000710 T
where : DEN is density of fresh oil at T (g/ml)
T is oil temperature (deg C)

	WEATHERING (%)		
TEMP (DEG C)	0	..	..
0	0.986(EETD 84) 0.980(MACKAY 82A) 0.969 TO 0.981(CURL 77)		
5	0.976(MACKAY 82A)		
10	0.973(MACKAY 82A) 0.963 TO 0.975(CURL 77)		
15	0.974(EETD 84) 0.969(MACKAY 82A)		
15.6	0.9710(API 81) 0.963(YUEN 70) 0.959 TO 0.972(CURL 77)		
20	0.966(MACKAY 82A) 0.956 TO 0.970(CURL 77)		
25	0.964(MACKAY 82A)		
30	0.950 TO 0.964(CURL 77)		

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (%)		
	0	..	..
0	7.35*10**7(TWARDUS 80)		
10	2.87*10**7(TWARDUS 80)		
20	5.98*10**6(TWARDUS 80)		
25	3180(MACKAY 82A)		
50	545(YUEN 70)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (%)		
	0	..	..
10	>1000(CURL 77)		
20	>500(CURL 77)		
40	>130(CURL 77)		
55	90 TO 2000(CURL 77)		
60	65 TO 1000(CURL 77)		
70	65 TO 360(CURL 77)		
80	65 TO 180(CURL 77)		

NOTE: DATA OBTAINED FROM A GRAPH

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm): 27 @ ROOM TEMP (TWARDUS 80)

6.2 OIL-WATER (mN/m or dynes/cm): 39.82 @ ROOM TEMP (TWARDUS 80)

7.0 POUR POINT (DEG C):

WEATHERING (%)	POUR POINT (DEG C)
0	6(MACKAY 82A) 7(TWARDUS 80) 2(FINGAS 79) <16(CURL 77) -1(YUEN 70)

8.0 FLASH POINT (DEG C):

WEATHERING (%)	FLASH POINT (DEG C)
0	>110(C.C.)(EETD 84) 66(OHMSTADS 81) 60 MIN(ASTM D 396) 174(O.C.)(TWARDUS 80) 80(FINGAS 79) >66(CURL 77) 99(YUEN 70)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)
0	115(TWARDUS 80) 151(API 81)
5	222(API 81)
10	310(TWARDUS 80) 248(API 81)
15	259(API 81)
20	335(TWARDUS 80) 267(API 81)

10.0 ASTM DISTILLATION DATA CONT'D:

VOLUME PERCENT	TEMP (DEG C)
25	272(API 81)
30	345(TWARDUS 80) 277(API 81)
35	282(API 81)
40	350(TWARDUS 80) 286(API 81)
45	293(API 81)
50	355(TWARDUS 80) 299(API 81)
55	304(API 81)
60	367(TWARDUS 80) 312(API 81)
65	318(API 81)
70	370(TWARDUS 80) 326(API 81)
75	375(TWARDUS 80) 333(API 81)
80	344(API 81)
85	357(API 81)
90	387(API 81)
95	417(API 81)
FBP	441(API 81)

NOTE: (API 81) DATA FROM SIMULATED DISTILLATION METHOD ASTM D 2887

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	0.1(EETD 84)		
15	0(EETD 84)		

NOTE: BUNKER C FROM THE ARROW INCIDENT FORMED STABLE EMULSIONS (YUEN 70)

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	0.2(EETD 84)		
15	0.1(EETD 84)		

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	N/A(EETD 84)		
15	N/A(EETD 84)		

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	0(EETD 85)		
15	3(EETD 85)		

14.2 NATURAL DISPERSIBLITY (% DISPERSED):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	0(EETD 85)		
15	0(EETD 85)		

15.0 OTHERS:

15.1 IN-SITU COMBUSTION OF FRESH OIL: RELATIVELY LONG IGNITION TIME (1.9 MIN), 26.4 VOL % RESIDUE (TWARDUS 80)

15.2 AUTO IGNITION POINT (DEG C): 408 (OHMTADS 81)
407 (CURL 77)

15.3 BOILING POINT (DEG): 400 (OHMTADS 81)

15.4 TOTAL ASH CONTENT (WT %): 0.08 (YUEN 70)

15.5 POLAR CONTENT (WT %): 14.9 (MACKAY 82A)

15.6 NITROGEN CONTENT (WT %): 0.34(API 81)
0.94(PANCIROV 74)

15.7 FIRE POINT (DEG C): >257(TWARDUS 80), 164(YUEN 70)

15.8 INITIAL BOILING POINT (DEG C): 180 TO 500(FINGAS 79)

15.9 PARAFFINS (WT %): 24.4(MACKAY 82A)
15(CURL 77)

15.10 AROMATICS (WT %): 54.6(MACKAY 82A)
25(CURL 77)

15.11 WAX (WT %): 55.4(MACKAY 82A)

15.12 ASPHALTENES (WT %): 6.17(MACKAY 82A), 9.28(YUEN 70),
45(CURL 77)

15.13 CARBON RESIDUE (WT %): 12.00(YUEN 70)

15.14 SULPHUR (WT %): 2.40(API 81),1.46(PANCIROV 74),
2.24(YUEN 70)

15.15 METALS (PPM): NICKEL: 62(API 81),89(PANCIROV 74),
35(YUEN 70)
VANADIUM: 25 TO 26(API 81),
73(PANCIROV 74),
272(YUEN 70)

15.16 TOXICITY:
LC50:
ATLANTIC SALMON, FRESH WATER, 15 C: >10,000 PPM
ATLANTIC SALMON, FRESH WATER, 5 C: >10,000 PPM
WINTER FLOUNDERS, SEA WATER, 5 C: >10,000 PPM
AMERICAN LOBSTERS, SEA WATER, 5 C: >10,000 PPM
(YUEN 70)
COMBUSTION PRODUCTS: NO GREAT HAZARD(OHMTADS 81)
POTENTIAL FOR ACCUMULATION: NEGATIVE(OHMTADS 81)

1.0 TYPE: COLD LAKE CRUDE OIL, ALBERTA. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml): @ ? TEMP , 0.9031(AALUND 83A)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt): @ 15 DEG C, 70.7 (AALUND 83A)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -60(AALUND 83A)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 SULFUR (WT %): 2.91(AALUND 83A)

15.2 NITROGEN (WT %): 0.29(AALUND 83A)

1.0 TYPE: EKOFISK CRUDE OIL, PHILLIPS. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 35.6(HMSO 76)

4.0 DENSITY (g/ml): @ 15 DEG C, 0.847(HMSO 76)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt): @ 50 DEG C, 4.25(HMSO 76)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -5 (-12)(HMSO 76)
NOTE: FIGURES IN BRACKETS ARE OBTAINED FROM THE OIL INDUSTRY AND ARE THOSE WHICH DONOT AGREE WITH THE PUBLISHED DATA. (HMSO 76)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

WEIGHT PERCENT	TEMP (DEG C)
7	5 TO 100(HMSO 76),(CORM 78)
11.1	100 TO 160(HMSO 76),(CORM 78)
15.1	160 TO 250(HMSO 76),(CORM 78)
19	250 TO 350(HMSO 76),(CORM 78)
47.8	>350(HMSO 76),(CORM 78)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 SULFUR (WT %): 0.18(HMSO 76)

15.2 WAX (WT %): 6.5(HMSO 76)

15.3 ASPHALTENES (WT %): 0.03(CORM 78)

1.0 TYPE: NEW ELECTRICAL INSULATING OIL. VOLTESSO 35. SAMPLE OBTAINED FROM ONTARIO HYDRO. NAPHTHENIC-BASED OIL FOR USE IN ELECTRICAL TRANSFORMERS, CIRCUIT BREAKERS AND OTHER KINDS OF ELECTRICAL EQUIPMENT.

2.0 COLOUR: 0.5(ESSO 84)

3.0 API GRAVITY:

4.0 DENSITY (g/mL):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	0.8922(EETD 85)		
15	0.8818(EETD 85) 0.8666(ESSO 84)		

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	37.8(EETD 85)		
15	18.8(EETD 85)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (VOL %)		
	0	..	..
-45	5000(ESSO 84)		
-40	2000(ESSO 84)		
-30	600(ESSO 84)		
0	42.4(EETD 85) 50(ESSO 84)		
15	21.3(EETD 85)		
40	8.0(ESSO 84)		
100	2.2(ESSO 84)		

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %)		
	0	..	..
0	30.2(EETD 85)		
15	29.6(EETD 85)		

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %)		
	0	..	..
0	17.7(EETD 85)		
15	14.2(EETD 85)		

6.3 OIL-WATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	20.2(EETD 85)		
15	19.8(EETD 85)		

7.0 POUR POINT (DEG C): <-34(EETD 85)
-51(ESSO 84)

8.0 FLASH POINT (DEG C): >110(C.C.)(EETD 85)
151(COC)(ESSO 84)

9.0 VAPOUR PRESSURE (kPa): @40 deg C, 3 microns(ESSO 84)
@100 deg C, 350 microns(ESSO 84)
@150 deg C, 5mm(ESSO 84)
@200 deg C, 45mm(ESSO 84)

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)
10	278
20	297
50	336
90	390
95	404

(ESSO 84)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	0(EETD 85)		
15	0(EETD 85)		

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	0(EETD 85)		
15	0(EETD 85)		

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	N/A(EETD 85)		
15	N/A(EETD 85)		

12.0 WEATHERING: Note: Insulating oil did not weather when stripped by air at room temperature.

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	23.3(EETD 85)		
15	25.4(EETD 85)		

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	72(EETD 85)		
15	94(EETD 85)		

14.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	21(EETD 85)		
15	21(EETD 85)		

15.0 OTHERS:

15.1 WATER SATURATION LEVELS (PPM):
@0 deg C, 16
@10 deg C, 27
@15 deg C, 35
@20 deg C, 45
@25 deg C, 56 (ESSO 84)

15.2 SULPHUR (WT %): 0.15(ESSO 84)

15.3 ANILINE POINT (deg C): 81(ESSO 84)

15.4 FIRE POINT (deg C): 177(COC)(ESSO 84)

15.5 AIR SOLUBILITY (VOL %): @15.6 deg C, 9.8(ESSO 84)

15.6 TOTAL ACID No.: NIL(ESSO 84)

15.7 OCCUPATIONAL EXPOSURE LIMIT (mg/m^3):
FOR OIL MISTS: 5(ACGIH 83)

1.0 TYPE: USED ELECTRICAL INSULATING OIL. VOLTESSO 35. SAMPLE OBTAINED FROM ONTARIO HYDRO. NAPHTHENIC-BASED OIL USED IN ELECTRICAL TRANSFORMERS, CIRCUIT BREAKERS AND OTHER KINDS OF ELECTRICAL EQUIPMENT.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/mL):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	0.8779(EETD 85)		
15	0.8673(EETD 85)		

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	35.8(EETD 85)		
15	18.1(EETD 85)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	40.8(EETD 85)		
15	20.9(EETD 85)		

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	30.6(EETD 85)		
15	29.5(EETD 85)		

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	23.9(EETD 85)		
15	16.7(EETD 85)		

6.3 OIL-WATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	24.1(EETD 85)		
15	23.6(EETD 85)		

7.0 POUR POINT (DEG C): <-34(EETD 85)

8.0 FLASH POINT (DEG C): >110(C.C.)(EETD 85)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP		WEATHERING (VOL %)	
(DEG C)	0	..	..
0	0(EETD 85)		
15	0(EETD 85)		

11.2 EMULSION STABILITY:

TEMP		WEATHERING (VOL %)	
(DEG C)	0	..	..
0	0(EETD 85)		
15	0(EETD 85)		

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP		WEATHERING (VOL %)	
(DEG C)	0	..	..
0	N/A(EETD 85)		
15	N/A(EETD 85)		

12.0 WEATHERING: Note: Insulating oil did not weather when stripped by air at room temperature.

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	16.7(EETD 85)		
15	23.0(EETD 85)		

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILITY (% DISPERSED):

OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	72(EETD 85)		
15	95(EETD 85)		

14.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	20(EETD 85)		
15	21(EETD 85)		

15.0 OTHERS:

1.0 TYPE: NEW "LUBE 27" GRADE LUBRICATING OIL.
SAMPLE OBTAINED FROM ONTARIO HYDRO. LUBE 27 IS USED IN HYDRAULIC TURBINE AND GOVERNOR SYSTEMS OF HYDRAULIC GENERATING STATIONS.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/mL):

TEMP (DEG C)	WEATHERING (VOL %)		
	0	..	..
0	0.8820(EETD 85)		
15	0.8727(EETD 85)		

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (VOL %)		
	0	..	..
0	350(EETD 85)		
15	144(EETD 85)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (VOL %)		
	0	..	..
0	396.8(EETD 85)		
15	165(EETD 85)		

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP	WEATHERING (VOL %)		
(DEG C)	0	..	..
0	32.8(EETD 85)		
15	31.2(EETD 85)		

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP	WEATHERING (VOL %)		
(DEG C)	0	..	..
0	19.0(EETD 85)		
15	13.6(EETD 85)		

6.3 OIL-WATER (mN/m or dynes/cm):

TEMP	WEATHERING (VOL %)		
(DEG C)	0	..	..
0	22.3(EETD 85)		
15	19.4(EETD 85)		

7.0 POUR POINT (DEG C): -24(EETD 85)

8.0 FLASH POINT (DEG C): >110(C.C.)(EETD 85)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	0(EETD 85)		
15	0(EETD 85)		

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	0(EETD 85)		
15	0(EETD 85)		

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	N/A(EETD 85)		
15	N/A(EETD 85)		

12.0 WEATHERING: Note: Lube 27 did not weather when stripped by air at room temperature.

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP	WEATHERING (VOL %)		
(DEG C)	0	..	..
0	19.4(EETD 85)		
15	24.4(EETD 85)		

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILITY (% DISPERSED)
OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP	WEATHERING (VOL,%)		
(DEG C)	0	..	..
0	49(EETD 85)		
15	27(EETD 85)		

14.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP	WEATHERING (VOL %)		
(DEG C)	0	..	..
0	4(EETD 85)		
15	13(EETD 85)		

15.0 OTHERS:

1.0 TYPE: USED "LUBE 27" GRADE LUBRICATING OIL. SAMPLE OBTAINED FROM ONTARIO HYDRO. LUBE 27 IS USED IN HYDRAULIC TURBINE AND GOVERNOR SYSTEMS OF HYDRAULIC GENERATING STATIONS.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/mL):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	0.8834(EETD 85)		
15	0.8737(EETD 85)		

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	359(EETD 85)		
15	154(EETD 85)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	406(EETD 85)		
15	176(EETD 85)		

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	31.9(EETD 85)		
15	31.0(EETD 85)		

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	21.8(EETD 85)		
15	11.4(EETD85)		

6.3 OIL-WATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	24.4(EETD 85)		
15	22.0(EETD 85)		

7.0 POUR POINT (DEG C): -27(EETD 85)

8.0 FLASH POINT (DEG C): >110(C.C.)(EETD 85)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	0(EETD 85)		
15	0(EETD 85)		

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	0(EETD 85)		
15	0(EETD 85)		

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	N/A(EETD 85)		
15	N/A(EETD 85)		

12.0 WEATHERING: Note: Lube 27 did not weather when stripped by air at room temperature.

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP	WEATHERING (VOL %)		
(DEG C)	0	..	..
0	17.5(EETD 85)		
15	26.8(EETD 85)		

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP	WEATHERING (VOL %)		
(DEG C)	0	..	..
0	52(EETD 85)		
15	29(EETD 85)		

14.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP	WEATHERING (VOL %)		
(DEG C)	0	..	..
0	3(EETD 85)		
15	13(EETD 85)		

15.0 OTHERS:

1.0 TYPE: FEDERATED LIGHT AND MEDIUM CRUDE OIL, ALBERTA.
TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 39.7(AALUND 83A)

4.0 DENSITY (g/ml): @ 21 DEG C, 0.8258(AALUND 83A)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt): @ 40 DEG C,
42.42(AALUND 83A)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -10.0(AALUND 83A)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa): 31.0(AALUND 83A)

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 SULFUR (PPM): 2,010(AALUND 83A)

15.2 CARBON RESIDUE (WT %): 1.46(AALUND 83A)

15.3 METALS (PPM): NICKEL: 0.07(AALUND 83A)
VANADIUM: 0.00(AALUND 83A)

15.4 NITROGEN (WT %): 0.11(AALUND 83A)

15.5 WAX (WT %): 9.12(AALUND 83A)

1.0 TYPE: FORTIES CRUDE OIL, BP. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 37.35(HMSO 76), 37.4 (LYNCH 81)

4.0 DENSITY (g/ml): @ 15 DEG C, 0.838(HMSO 76)
@ 16 DEG C, 0.8373(LYNCH 81)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt): @ 50 DEG C, 3.7(LYNCH 81); @ 50 DEG C, 3.7(HMSO 76)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -1(HMSO 76); -3(LYNCH 81)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

WEIGHT PERCENT	TEMP (DEG C)
7.9	5 TO 100(HMSO 76),(LYNCH 81)
11.7	100 TO 160(HMSO 76),(LYNCH 81)
12.5	160 TO 250(HMSO 76),(LYNCH 81)
21.9	250 TO 350(HMSO 76),(LYNCH 81)
46.0	>350(HMSO 76),(LYNCH 81)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 SULFUR (WT %): 0.29(HMSO 76)

15.2 WAX (WT %): 9(HMSO 76); 9(LYNCH 81)

15.3 ASPHALTENES (WT %): 0.2 (IP METHOD 143/57)(LYNCH 81)

1.0 TYPE: FUEL OIL NO.1, KEROSENE. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	0.837 TO 0.847(CURL 77)		
15	0.827 TO 0.850(CURL 77)		
20	0.823 TO 0.847(CURL 77)		

NOTE: DATA OBTAINED FROM A GRAPH

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	3.1 TO 5.0(CURL 77)		
15	2.1 TO 3.5(CURL 77)		
20	1.9 TO 3.3(CURL 77)		

NOTE: DATA OBTAINED FROM A GRAPH

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -18(CURL 77)

8.0 FLASH POINT (DEG C): 38 TO 74(CURL 77)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 AUTO-IGNITION TEMPERATURE (DEG C): 229(CURL 77)

15.2 EXPLOSION LIMITS OF VAPOUR IN AIR:
UPPER: 5.0%(CURL 77)
LOWER: 0.7%(CURL 77)

15.3 BOILING RANGE (DEG C): 174 TO 266(CURL 77)

15.4 AROMATICS (WT %): 12(CURL 77)

15.5 PARAFFINS (WT %): 32(CURL 77)

15.6 NAPHTHENES (WT %): 56(CURL 77)

1.0 TYPE: FUEL OIL NO.1 (JET FUEL, J.P.-1). TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml):

5.0 VISCOSITY:

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C):

8.0 FLASH POINT (DEG C): 35 TO 63(CURL 77)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 AUTO-IGNITION TEMPERATURE (DEG C): 229(CURL 77)

1.0 TYPE: FUEL OIL NO.1 (JET FUEL, J.P.-4).
65% GASOLINE, 35% LIGHT PETROLEUM DISTILLATES
(CURL 77). TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml): @ 15 DEG C, APPROX. 0.80(NAVAL 77)

5.0 VISCOSITY:

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C):

8.0 FLASH POINT (DEG C): -23 TO -1(CURL 77),
APPROX. -25(NAVAL 77)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 AUTO-IGNITION TEMPERATURE (DEG C): 242(CURL 77)

1.0 TYPE: FUEL OIL NO.1 (JET FUEL, J.P.-5). SPECIALLY REFINED KEROSENE (CURL 77).TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml): @ 15 DEG C, MAXIMUM 0.844(NAVAL 77)

5.0 VISCOSITY:

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C):

8.0 FLASH POINT (DEG C): 35 TO 63(CURL 77),
MINIMUM 60(NAVAL 77)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 AUTO-IGNITION TEMPERATURE (DEG C): 246(CURL 77)

1.0 TYPE: FUEL OIL NO.1 (JET FUEL, J.P.-6). A HIGHER KEROSENE CUT THAN J.P.-4 WITH FEWER IMPURITIES. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml):

5.0 VISCOSITY:

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C):

8.0 FLASH POINT (DEG C): 38(CURL 77)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 AUTO-IGNITION TEMPERATURE (DEG C): 224(CURL 77)

1.0 TYPE: FUEL OIL NO.2. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 30 MIN(ASTM 80), 31.6(PANCIROV 74)

4.0 DENSITY (g/ml):

TEMP (DEG C)	WEATHERING (%)		
	0	..	..
0	0.874(EETD 84) 0.849(MACKAY 82B) 0.865 TO 0.908(CURL 77)		
15	0.866(EETD 84) 0.855 TO 0.898(CURL 77)		
16.5	0.8762 MAX(ASTM D 396) 0.854 TO 0.897(CURL 77)		
20	0.840(MACKAY 82B)		

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (%)		
	0	..	..
0	7.74(MACKAY 82B)		
20	4.04(MACKAY 82B)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (%) 0	..	..
15	2.53 TO 6.13(CURL 77)		
38	2.0 TO 3.6(ASTM D 396) 1.53 TO 3.19(CURL 77)		
40	1.9 TO 3.4(ASTM D 396) 1.47 TO 3.01(CURL 77)		

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	29.0(EETD 84)		
15	27.4(EETD 84)		
20	26.2(MACKAY 82B)		

6.2 OIL-SEAWATER (mN/m or dynes/cm)

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	16.2(EETD 84)		
15	13.6(EETD 84)		
20	25.6(MACKAY 82B)		

6.3 OIL-WATER (mN/m or dynes/cm)

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	15.1(EETD 85)		
15	14.7(EETD 85)		

7.0 POUR POINT (DEG C):

WEATHERING (%)	POUR POINT (DEG C)
0	-27(MACKAY 82B)
	-6 MAX(ASTM D 396)
	-20(FINGAS 79)
	-7(CURL 77)

8.0 FLASH POINT (DEG C):

WEATHERING (%)	FLASH POINT (DEG C)
0	104(MACKAY 82B)
	38 MIN(ASTM D 396)
	91(C.C.)(EETD 84)
	52-96(EETD 84)
	55(FINGAS 79)
	38(CURL 77)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)
INITIAL	180 TO 360 (FINGAS 79)
90	282 TO 338(ASTM D 396)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP	WEATHERING (%)		
(DEG C)	0	..	..
0	0(EETD 84)		
15	0(EETD 84)		

11.2 EMULSION STABILITY: FORMS NO EMULSION (MACKAY 82B)

TEMP	WEATHERING (%)		
(DEG C)	0	..	..
0	0(EETD 84)		
15	0(EETD 84)		

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP	WEATHERING (%)		
(DEG C)	0	..	..
0	N/A(EETD 84)		
15	N/A(EETD 84)		

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP	WEATHERING (%)		
(DEG C)	0	..	..
0	26.0(EETD 84)		
15	28.2(EETD 84)		

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILTY (% DISPERSED):
OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP	WEATHERING (%)		
(DEG C)	0	..	..
0	86(EETD 85)		
15	75(EETD 85)		

14.2 NATURAL DISPERSIBILTY (% DISPERSED):

TEMP	WEATHERING (%)		
(DEG C)	0	..	..
0	26(EETD 85)		
15	24(EETD 85)		

15.0 OTHERS:

15.1 AUTO-IGNITION POINT (DEG C): 257 (OHMTADS 81)

15.2 BOILING POINT (DEG C): 232 (OHMTADS 81)

15.3 BOILING RANGE (DEG C): 34 TO 185(CURL 77)

15.4 ODOUR THRESHOLD,MEDIUM (PPM): 0.082 (OHMTADS 81)

15.5 COLOUR IN WATER: DARK BLUE PURPLE (OHMTADS 81)

15.6 NITROGEN CONTENT (WT %): 0.024 (PANCIROV 74)

15.7 SULPHUR (WT %): 0.5 MAX(ASTM D 396),0.32(PANCIROV 74)

15.8 METALS (PPM): NICKEL: 0.5(PANCIROV74)
VANADIUM: 1.5(PANCIROV 74)

15.9 TOXICITY:
COMBUSTION PRODUCT TOXICITY: NO GREAT HAZARD (OHMTADS 81)
POTENTIAL FOR ACCUMULATION: NEGATIVE (OHMTADS 81)
GENERAL EFFECT: INHALATION: HEADACHE, & STUPOR (OHMTADS 81)

15.10 AQUEOUS SOLUBILITY (mg/L): 3.12 @ 20 DEG C (MACKAY 82B)

1.0 TYPE: FUEL OIL NO. 4.
IT CAN BE A HIGH-BOILING-DISTILLATE OR A LIGHT RESIDUAL OF CRUDE OIL, OR IT CAN BE PREPARED BY BLENDING 40% FUEL OIL NO.2 AND 60% FUEL OIL NO.6. (CURL 77). TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	0.914 TO 0.922(CURL 77) 0.938(MACKAY 82B)		
15	0.904 TO 0.912(CURL 77)		
20	0.901 TO 0.909(CURL 77) 0.925(MACKAY 82B)		
30	0.895 TO 0.902(CURL 77)		

NOTE: (CURL 77) DATA OBTAINED FROM A GRAPH

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (%) 0	..	..
10	47.2(MACKAY 82B)		
20	22.7(MACKAY 82B)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (%) 0	..	..
10	40 TO 101(CURL 77)		
15	33 TO 79(CURL 77)		
20	27 TO 60(CURL 77)		
30	18 TO 38(CURL 77)		
40	11 TO 26(CURL 77)		

NOTE: DATA OBTAINED FROM A GRAPH (CURL 77)

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm): @ 20 DEG C, 32.1 (MACKAY 82B)

6.2 OIL-SEAWATER (mN/m or dynes/cm): @ 20 DEG C, 30.23 (MACKAY 82B)

7.0 POUR POINT (DEG C): -7(CURL 77), -3(MACKAY 82B)

8.0 FLASH POINT (DEG C): 54(CURL 77), 78(MACKAY 82B)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 EMULSION FORMATION TENDENCY & STABILITY: FORMS STABLE EMULSION (MACKAY 82B)

15.2 AUTO-IGNITION TEMPERATURE (DEG C): 263(CURL 77)

15.3 AQUEOUS SOLUBILITY (mg/L): @ 20 DEG C, 6.46 (MACKAY 82B)

1.0 TYPE: FUEL OIL NO. 5, NAVY SPECIAL OR BUNKER B. CAN BE PREPARED BY ADDING 20 TO 25% FUEL OIL NO. 2 TO 75 TO 80% FUEL OIL NO.6 (CURL 77) LIGHT FUEL OIL NO.5 AND HEAVY FUEL OIL NO.5 (CURL 77). TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: MINIMUM 11.5(NAVAL 77)

4.0 DENSITY (g/ml):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	0.932 TO 0.957(CURL 77)		
15	0.923 TO 0.948(CURL 77)		
20	0.920 TO 0.945(CURL 77)		
30	0.913 TO 0.938(CURL 77)		

NOTE: DATA OBTAINED FROM A GRAPH (CURL 77)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	FUEL OIL No.5 LIGHT	FUEL OIL No.5 HEAVY
10	200 TO 473(CURL 77)	>473(CURL 77)
15	152 TO 313(CURL 77)	>313(CURL 77)
20	123 TO 233(CURL 77)	>233(CURL 77)
25	100 TO 165(CURL 77)	165 TO 327(CURL 77)
30	74 TO 125(CURL 77)	125 TO 200(CURL 77)
40	40 TO 75(CURL 77)	75 TO 100(CURL 77)

NOTE: DATA OBTAINED FROM A GRAPH (CURL 77)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): MAXIMUM -9.4(NAVAL 77)

8.0 FLASH POINT (DEG C): >54(CURL 77), MINIMUM 60(NAVAL 77)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

1.0 TYPE: GULF ALBERTA L & M CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 35.1(AALUND 83A)

4.0 DENSITY (g/ml): @ 21 DEG C, 0.8486(AALUND 83A)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):
@ 40 DEG C, 4.86 (AALUND 83A)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -27.5(AALUND 83A)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa): 36.4 (AALUND 83A)

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 SULFUR (PPM): 9,800(AALUND 83A)

15.2 H2S (PPM): 58.1(AALUND 83A)

15.3 METALS (PPM): NICKEL: 10.10(AALUND 83)
VANADIUM: 9.00(AALUND 83)

1.0 TYPE: HI-AROMATIC HEATING OIL.

2.0 COLOUR:

3.0 API GRAVITY: 33.7(API 81)

4.0 DENSITY (g/ml): @ 15.6 DEG C, 0.8558(API 81)

5.0 VISCOSITY:

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C):

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)
IBP	138(API 81)
5	181(API 81)
10	199(API 81)
15	210(API 81)
20	219(API 81)
25	227(API 81)
30	235(API 81)
35	245(API 81)
40	253(API 81)
45	261(API 81)
50	269(API 81)
55	275(API 81)
60	282(API 81)
65	288(API 81)
70	297(API 81)
75	305(API 81)
80	316(API 81)
85	325(API 81)
90	336(API 81)
95	352(API 81)
FBP	387(API 81)

NOTE: (API 81) DATA FROM SIMULATED DISTILLATION ASTM METHOD D 2887

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 SULFUR (WT %): 0.12(API 81)

15.2 NITROGEN (WT %): 0.009(API 81)

15.3 METALS (PPM): NICKEL: 0.1(API 81)
VANADIUM: 0.1 TO 0.3(API 81)

1.0 TYPE: TYPICAL HEATING OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 32.1(API 81)

4.0 DENSITY (g/ml): @ 15.6 DEG C, 0.8641(API 81)

5.0 VISCOSITY:

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C):

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)
IBP	116(API 81)
5	171(API 81)
10	194(API 81)
15	207(API 81)
20	216(API 81)
25	226(API 81)
30	233(API 81)
35	243(API 81)
40	251(API 81)
45	258(API 81)
50	267(API 81)
55	273(API 81)
60	280(API 81)
65	287(API 81)
70	297(API 81)
75	306(API 81)
80	317(API 81)
85	327(API 81)
90	339(API 81)
95	356(API 81)
FBP	399(API 81)

NOTE: (API 81) DATA FROM SIMULATED DISTILLATION ASTM METHOD D 2887

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 SULFUR (WT %): 0.19(API 81)

15.2 NITROGEN (WT %): 0.014(API 81)

15.3 METALS (PPM): NICKEL: <0.1 TO 0.1(API 84)
VANADIUM: 0.1 TO 0.2(API 81)

1.0 TYPE: HIBERNIA CRUDE OIL.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/mL):

For Fv < 23.0 % & T between 0 and 15 deg C:
DEN = 0.877086 + 0.001632 Fv - 0.000791 T
where: DEN is density of oil at T and Fv (g/mL)
Fv is volume percent of oil weathered
T is oil temperature (deg C)

TEMP (DEG C)	WEATHERING (VOL %) 0	18.2	23.0
0	0.8773(EETD 85)	0.9070(EETD 85)	0.9142(EETD 85)
15	0.8648(EETD 85)	0.8957(EETD 85)	0.9024(EETD 85)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (VOL %) 0	18.2	23.0
0			
15			

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (VOL %) 0	18.2	23.0
0			
15			

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	18.2	23.0
0	29.0(EETD 85)	N/M(EETD 85)	N/M(EETD 85)
15	27.2(EETD 85)	28.8(EETD 85)	30.6(EETD 85)

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	18.2	23.0
0	24.2(EETD 85)	N/M(EETD 85)	N/M(EETD 85)
15	21.0(EETD 85)	19.5(EETD 85)	32.7(EETD 85)

6.3 OIL-WATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	18.2	23.0
0	26.4(EETD 85)	N/M(EETD 85)	N/M(EETD 85)
15	23.4(EETD 85)	22.0(EETD 85)	38.7(EETD 85)

7.0 POUR POINT (DEG C):

WEATHERING (WT %)	POUR POINT (DEG C)
0	12(EETD 85)
18.2	14(EETD 85)
23.0	19(EETD 85)

8.0 FLASH POINT (DEG C): -10 (C.C)(EETD 85)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C) MODIFIED ASTM DISTILLATION:	ASTM DISTILLATION:
IBP	147	43
5	175	99
10	206	120
15	238	138
20	270	171
25	297	199
	(MODIFIED ASTM D 86) (EETD 85)	(ASTM D 86) (EETD 85)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP		WEATHERING (VOL %)	
(DEG C)	0	18.2	23.0
0			
15	1.0(EETD 85)		

11.2 EMULSION STABILITY:

TEMP		WEATHERING (VOL %)	
(DEG C)	0	18.2	23.0
0			
15	1.0(EETD 85)		

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP		WEATHERING (VOL %)	
(DEG C)	0	18.2	23.0
0			
15	88.7(EETD 85)		

12.0 WEATHERING:

$$Fv = \frac{\ln(1 + 6143\ O\ \exp(6.3 - 4326/TK)/TK)}{(6143/TK)}$$

where: Fv is fraction of oil weathered by volume
ln is natural log
O is evaporation exposure
exp is exponential base e
TK is environmental temperature
(Kelvin, K = deg C + 273)

(EETD 85)

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	18.2	23.0
0	18.0(EETD 85)	<0(EETD 85)	<0(EETD 85)
15	21.0(EETD 85)	20.9(EETD 85)	5.9(EETD 85)

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILITY (% DISPERSED):

OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (DEG C)	WEATHERING (VOL %) 0	18.2	23.0
0	10(EETD 85)	4(EETD 85)	0(EETD 85)
15	48(EETD 85)	46(EETD 85)	19(EETD 85)

14.2 NATURAL DISPERSIBILITY:

TEMP (DEG C)	WEATHERING (VOL %) 0	18.2	23.0
0	0(EETD 85)	0(EETD 85)	0(EETD 85)
15	0(EETD 85)	0(EETD 85)	0(EETD 85)

15.0 OTHERS:

1.0 TYPE: ISSUNGNAK CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml):

For Fv < 25.0 % & T between 0 and 15 deg C:

DEN = 0.861749 + 0.001289 Fv - 0.001213 T
where: DEN is density of oil at T and Fv (g/mL)
Fv is volume percent of oil weathered
T is oil temperature (deg C)

TEMP (DEG C)	WEATHERING 0	4(%)	12(%)	15.1(vol%)	25.0(vol%)
0	0.8636 (EETD 85)			0.8806 (EETD 85)	0.8897 (EETD 85)
15	0.849 (EETD 84)			0.8682 (EETD 85)	0.8773 (EETD 85)
20	0.8284 (ESSO 83)	0.8459 (ESSO 83)	0.8469 (ESSO 83)		

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (%) 0	4	12
-10	DNF(ESSO 83)	DNF(ESSO 83)	DNF(ESSO 83)
0	199.4(ESSO 83)	DNF(ESSO 83)	DNF(ESSO 83)
15	3.652(ESSO 83)	6.008(ESSO 83)	6.248(ESSO 83)
25	3.005(ESSO 83)	4.564(ESSO 83)	4.566(ESSO 83)

NOTE: DNF = DID NOT FLOW

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

		WEATHERING (VOL %)	
TEMP (DEG C)	0	15.1	25.0
0	31.3(EETD 85)	N/M(EETD 85)	N/M(EETD 85)
15	26.2(EETD 85)	27.7(EETD 85)	28.5(EETD 85)

6.2 OIL-SEAWATER (mN/m or dynes/cm):

		WEATHERING (VOL %)	
TEMP (DEG C)	0	15.1	25.0
0	28.2(EETD 85)	N/M(EETD 85)	N/M(EETD 85)
15	16.8(EETD 85)	17.0(EETD 85)	12.5(EETD 85)

6.3 OIL-WATER (mN/m or dynes/cm):

		WEATHERING (VOL %)	
TEMP (DEG C)	0	15.1	25.0
0	30.7(EETD 85)	N/M(EETD 85)	N/M(EETD 85)
15	16.7(EETD 85)	23.4(EETD 85)	21.5(EETD 85)

7.0 POUR POINT (DEG C):

WEATHERING (%)	POUR POINT (DEG C)
0	5(ESSO 83)
4	6(ESSO 83)
12	7(ESSO 83)
15.1	11(EETD 85)
25.0	13(EETD 85)

8.0 FLASH POINT (DEG C):

WEATHERING (%)	FLASH POINT (DEG C)
0	-10(ESSO 83)
4	-16(ESSO 83)
12	48(ESSO 83)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA (DEG C):

VOLUME PERCENT	WEATHERING (%) 0	4	12
INITIAL	-5(ESSO 83)	38(ESSO 83)	83(ESSO 83)
50	254(ESSO 83)	276(ESSO 83)	283(ESSO 83)
FINAL	448(ESSO 83)	544(ESSO 83)	538(ESSO 83)
FINAL VOL CONT'D	100 %(ESSO 83)	96 %(ESSO 83)	98 %(ESSO 83)

	WEATHERING (VOL %) 0		15.1	
VOLUME PERCENT	MODIFIED ASTM DISTIL'N	ASTM DISTIL'N	MODIFIED ASTM DISTIL'N	ASTM DISTIL'N
IBP	175	59	230	129
5	189	112	244	152
10	212	126	259	164
15	237	145	274	174
20	256	164	285	224
25	270	207	296	232
30	283	229	309	233
35	295	237		
40	305	255		
	(MODIFIED ASTM D 86) (EETD 85)	(ASTM D 86) (EETD 85)	(MODIFIED ASTM D 86) (EETD 85)	(ASTM D 86) (EETD 85)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (VOL %) 0	15.1	25.0
0			
15	0(EETD 85)		

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (VOL %) 0	15.1	25.0
0			
15	0(EETD 85)		

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (VOL %) 0	15.1	25.0
0			
15	N/A(EETD 85)		

12.0 WEATHERING:

$$Fv = \frac{\ln(1 + 2736\ O\ \exp(6.3 - 5181/TK)/TK)}{(2736/TK)}$$

where: Fv is fraction of oil weathered by volume
ln is natural log
O is evaporation exposure
exp is exponential base e
TK is environmental temperature
(Kelvin, K = deg C + 273)

(EETD 85)

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	15.1	25.0
0	11.7(EETD 85)	<0(EETD 85)	<0(EETD 85)
15	26.2(EETD 85)	24.5(EETD 85)	28.2(EETD 85)

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILITY (% DISPERSED):
OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (DEG C)	WEATHERING (VOL %) 0	15.1	25.0
0	16(EETD 85)	0(EETD 85)	0(EETD 85)
15	91(EETD 85)	99(EETD 85)	85(EETD 85)

14.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (DEG C)	WEATHERING (VOL %) 0	15.1	25.0
0	0(EETD 85)	0(EETD 85)	0(EETD 85)
15	34(EETD 85)	0(EETD 85)	0(EETD 85)

15.0 OTHERS:

15.1 FIRE POINT (DEG C):

WEATHERING (%)	FIRE POINT (DEG C)
0	-10(ENGELHARDT 84)
4	-16(ENGELHARDT 84)
12	57(ENGELHARDT 84)

1.0 TYPE: ISTHMUS/REFORMA/CACTUS REFORMA BLEND CRUDE OIL, MEXICO. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 33.0(McCASLIN 79)
32.7(PETRO-CAN 80)

4.0 DENSITY (g/ml): @ 15 deg C, 0.861(PETRO-CAN 80)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (%) 0	..	..
10	16.05(PETRO-CAN 80)		
15.9	22.9(McCASLIN 79)		
20	10.65(PETRO-CAN 80)		
37.8	7.1(PEREZ 79)		
39	6.81(McCASLIN 79)		

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -16(PEREZ 79)
-27(PETRO-CAN 80)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa): 22.8(McCASLIN 79),
38.6(PEREZ 79)

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 NAPHTHENES (VOL %): ABOUT 3.6(McCASLIN 79)

15.2 PARAFFINS (VOL %): ABOUT 12(McCASLIN 79)

15.3 AROMATICS (VOL %): ABOUT 1.4(McCASLIN 79)

15.4 ASPHALTENES (WT %): 0.9(PETRO-CAN 80)

15.5 CARBON RESIDUE (WT %): 3.5(RAMSBOTTOM)(PEREZ 79)
4.2(PETRO-CAN 80)

15.6 SULPHUR (WT %): 1.56(McCASLIN 79), 1.7(PEREZ 79)
1.7(PEREZ 79)
1.61(PETRO-CAN 80)

15.7 METALS (PPM): VANADIUM: 21.1(PEREZ 79),
30.0(PETRO-CAN 80)
NICKEL: 3.0(PEREZ 79)
5.0(PETRO-CAN 80)

15.8 YIELD ON CRUDE:

		WT %	VOL %
GAS TO C4		0.7	0.85
LT.DISTILLATE TO 149 deg C		14.55	17.5
KEROSINE	149-232 deg C	16.5	17.95
GAS OIL	232-342 deg C	19.5	19.8
RESIDUE	above 342 deg C	48.75	43.9

(PETRO-CAN 80)

1.0 TYPE: KOAKOAK 0-22 CRUDE OIL, BEAUFORT SEA.
TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 28.1(DOME 84)

4.0 DENSITY (g/ml): @ 21 DEG C, 0.8858(DOME 84);
@ 15.6 DEG C, 0.8887(DOME 84)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

		WEATHERING (%)	
TEMP (DEG C)	0	..	..
20	19.98(DOME 84)		
30	12.91(DOME 84)		
40	8.890(DOME 84)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -48(DOME 84)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY &STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

1.0 TYPE: KOAKOAK 0-22A CRUDE OIL, BEAUFORT SEA.
TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 29.5(DOME 84)

4.0 DENSITY (g/ml): @ 15.6 DEG C, 0.8785(DOME 84)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (%)		
	0	..	..
20	10.323(DOME 84)		
30	6.836(DOME 84)		
40	5.022(DOME 84)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): <60(DOME 84)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

1.0 TYPE: KOPANOAR CRUDE OIL, BEAUFORT SEA, TYPICAL DATA

2.0 COLOUR:

3.0 API GRAVITY: 25.7 (ENGLEHART 84)

4.0 DENSITY (g/mL):

TEMP (DEG C)	WEATHERING (WT %) 0	3.7	11.6
16	0.8992 (ENGLELHARDT 84)	0.9002 (ENGELHARDT 84)	0.9012 (ENGELHARDT 84)
20	0.900 (MACKAY 80A)	0.901 (MACKAY 80A)	0.902 (MACKAY 80A)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (WT %) 0	3.7	11.6
0	57 (ENGELHARDT 84)	75 (ENGELHARDT 84)	104 (ENGELHARDT 84)
15	33 (ENGELHARDT 84)	41 (ENGELHARDT 84)	54 (ENGELHARDT 84)
25	17.5 (ENGELHARDT 84)	24 (ENGELHARDT 84)	30 (ENGELHARDT 84)

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C):

WEATHERING (WT %)	POUR POINT (DEG C)
0	-37(ENGELHARDT 84)
3.7	-28(ENGELHARDT 84)
11.6	-19(ENGELHARDT 84)

8.0 FLASH POINT (DEG C):

WEATHERING (WT %)	FLASH POINT (DEG C)
0	75(ENGELHARDT 84)
3.7	86(ENGELHARDT 84)
11.6	118(ENGELHARDT 84)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 INITIAL BOILING POINT (DEG C): 84(MACKAY 80A)

15.2 FIRE POINT (DEG C):

WEATHERING (WT %)	FIRE POINT (DEG C)
0	85(MACKAY 80A)
3.7	98(MACKAY 80A)
11.6	125(MACKAY 80A)

15.3 AQUEOUS SOLUBILITY (mg/L):

WEATHERING (WT %)	AQUEOUS SOLUBILITY (mg/L)
0	10.4(MACKAY 80A)
3.7	8.9(MACKAY 80A)
11.6	3.0(MACKAY 80A)

1.0 TYPE: KOPANOAR 2I-44 CRUDE OIL, BEAUFORT SEA.
TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 29.3(DOME 84)

4.0 DENSITY (g/ml): @ 15.6 DEG C, 0.8685(DOME 84)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP	WEATHERING (%)		
(DEG C)	0	..	..
20	12.60(DOME 84)		
30	8.87(DOME 84)		
40	6.774(DOME 84)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -21.6(DOME 84)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

1.0 TYPE: KOPANOAR M-13 CRUDE OIL, BEAUFORT SEA.
TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 30.9(DOME 84)

4.0 DENSITY (g/ml): @ 15.6 DEG C, 0.8939(DOME 84)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (%)		
	0	..	..
10	61.4(DOME 84)		
20	33.97(DOME 84)		
30	21.67(DOME 84)		
40	14.38(DOME 84)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): 2.7(DOME 84)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

1.0 TYPE: KOPANOAR M-13A CRUDE OIL, BEAUFORT SEA.
TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 26.7(DOME 84)

4.0 DENSITY (g/ml): @ 21 DEG C, 0.8938(DOME 84)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)		WEATHERING (%)	
	0	..	..
0	219.8(DOME 84)		
4.4	128.0(DOME 84)		
10	74.85(DOME 84)		
15.4	43.21(DOME 84)		
20	40.12(DOME 84)		
30	28.46(DOME 84)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -17.5(DOME 84)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 WAX (WT %): 0.22(DOME 84)

1.0 TYPE: KUPARUK CRUDE OIL, ALASKA. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 23.0(AALUND 83)

4.0 DENSITY (g/ml): @ 21 DEG C, 0.9150(AALUND 83)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):
@ 15.6 DEG C, 79.98(AALUND 83)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -48.3(AALUND 83)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa): 17.94(AALUND 83)

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 CARBON RESIDUE (WT %): 7.37(AALUND 83)

15.2 METALS (PPM): NICKEL: 19(AALUND 83)
VANADIUM: 57(AALUND 83)

15.3 NITROGEN (PPM): 1,980(AALUND 83)

15.4 H_2S (mg/m^3): <361(AALUND 83)

1.0 TYPE: KUWAIT CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 31.1(LYNCH 81), 31.1(HMSO 76), 31.4(PANCIROV 74)

4.0 DENSITY (g/ml):

TEMP (DEG C)	WEATHERING (%)		
	0	9	38.1
16	0.8692(LYNCH 81)	0.895(CURL 77)	0.955(CURL 77)
15	0.870(HMSO 76)		

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (WT %)				
	0	15.1	19.5	26.7	33.0
10 (LYNCH 81)	19	97	163	865	2279

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt): @ 50 DEG C, 7.6 (HMSO 76),(LYNCH 81)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -20(LYNCH 81),(HMSO 76)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

WEIGHT PERCENT	TEMP (DEG C)
8.3	5 TO 100(LYNCH 81),(HMSO 76)
9.1	100 TO 160(LYNCH 81),(HMSO 76)
12.4	160 TO 250(LYNCH 81),(HMSO 76)
16.0	250 TO 350(LYNCH 81),(HMSO 76)
54.2	>350(LYNCH 81),(HMSO 76)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 SULFUR (WT %): 2.44(PANCIROV 74); 2.53(HMSO 76)

15.2 NITROGEN (WT %): 0.14(PANCIROV 74)

15.3 METALS (PPM): NICKEL: 7.7(PANCIROV 74)
VANADIUM: 28(PANCIROV 74)

15.4 WAX (WT %): 5.5(LYNCH 81)

15.5 ASPHALTENES (WT %): 1.45(LYNCH 81)(IP METHOD 143/57)

1.0 TYPE: LAGO MEDIO CRUDE OIL, VENEZUELA. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 32.6(McCASLIN 79)

4.0 DENSITY (g/ml):

DEN = 0.880 + 0.00167 Fv - 0.00056 T
Where: DEN is density at Fv & T (g/ml)
Fv is volume fraction weathered
T is oil temperature (deg C)

TEMP (DEG C)	WEATHERING (VOL %) 0	8.9	14.8
0	0.880(EETD 84)	0.898(EETD 84)	0.906(EETD 84)
15	0.872(EETD 84)	0.891(EETD 84)	0.897(EETD 84)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (VOL %) 0	8.9	14.8
0	4355(EETD 84)	7800(EETD 84)	16500(EETD 84)
15	41.1(EETD 84)	83.6(EETD 84)	265(EETD 84)

5.2 KINEMATIC VISCOSITY (mm ^{2}/sec or cSt):

TEMP (DEG C)	WEATHERING (VOL %) 0	8.9	14.8
0	4949(EETD 84)	8686(EETD 84)	18212(EETD 84)
15	47.1(EETD 84)	93.8(EETD 84)	295(EETD 84)

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	8.9	14.8
0	N/M(EETD 84)	N/M(EETD 84)	N/M(EETD 84)
15	28.2(EETD 84)	27.5(EETD 84)	29.6(EETD 84)

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	8.9	14.8
0	N/M(EETD 84)	N/M(EETD 84)	N/M(EETD 84)
15	12.4(EETD 84)	14.4(EETD 84)	17.1(EETD 84)

6.3 OIL-WATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	8.9	14.8
0	N/M(EETD 84)	N/M(EETD 84)	N/M(EETD 84)
15	23.2(EETD 84)	23.7(EETD 84)	20.5(EETD 84)

7.0 POUR POINT (DEG C): -26(McCASLIN 79)

8.0 FLASH POINT (DEG C): 57(C.C.)(EETD 84)

9.0 VAPOUR PRESSURE (kPa): 15.5(EETD 84)

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)		WEATHERING (VOL %)	
	0	8.9	14.8
0	0.9(EETD 84)	1.0(EETD 84)	1.0(EETD 84)
15	1.0(EETD 85)	1.0(EETD 85)	1.0(EETD 85)

11.2 EMULSION STABILITY:

TEMP (DEG C)		WEATHERING (VOL %)	
	0	8.9	14.8
0	0.92(EETD 84)	0.9(EETD 84)	1.0(EETD 84)
15	1.0(EETD 85)	1.0(EETD 85)	1.0(EETD 85)

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)		WEATHERING (VOL %)	
	0	8.9	14.8
0	89.1(EETD 84)	84.9(EETD 84)	73.4(EETD 84)
15	88.5(EETD 85)	87.2(EETD 85)	86.1(EETD 85)

12.0 WEATHERING:

$$Fv = \frac{\ln(1 + 6334.5\ O\ \exp(6.3 - 4717.4/TK)/TK)}{(6334.5/TK)}$$

where:
Fv is fraction of oil weathered by volume
ln is natural log
O is evaporation exposure
exp is exponential base e
TK is environmental temperature (Kelvin, K = deg C + 273)

(Stiver 82)

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	8.9	14.8
0	<0(EETD 84)	<0(EETD 84)	<0(EETD 84)
15	28.6(EETD 84)	27.3(EETD 84)	22.5(EETD 84)

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILITY (% DISPERSED):

OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (DEG C)	WEATHERING (VOL %) 0	8.9	14.8
0	73(EETD 85)	62(EETD 85)	20(EETD 85)
15	81(EETD 85)	69(EETD 85)	85(EETD 85)

14.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (DEG C)	WEATHERING (VOL %) 0	8.9	14.8
0	1(EETD 85)	<1(EETD 85)	0(EETD 85)
15	2(EETD 85)	5(EETD 85)	2(EETD 85)

15.0 OTHERS:

15.1 CARBON RESIDUE (WT %): 4.36(McCASLIN 79)

15.2 SULPHUR (WT %): 1.23(McCASLIN 79)

15.3 AQUEOUS SOLUBILITY (mg/L):

WEATHERING (WT %)	SOLUBILITY (mg/L)
0	25.5(BOBRA 83)
22.3	0.61(BOBRA 83)

1.0 TYPE: LAGOTRECO CRUDE OIL.
1961 PRODUCTION SAMPLE FROM BACHAQUERO/PUERTO MIRANDA EXPORT TERMINAL.

2.0 COLOUR:

3.0 API GRAVITY: 27.3(PETRO-CAN 72)

4.0 DENSITY (g/ml): @ 15 deg C, 0.891(PETRO-CAN 72)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):
@ 21 deg C, 34.8(PETRO-CAN 72)
@ 38 deg C, 17.5(PETRO-CAN 72)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -48(PETRO-CAN 72)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 CARBON RESIDUE (WT %): 5.3(PETRO-CAN 72)

15.2 ASPHALTENES (WT %): 2.0 (PETRO-CAN 72)

15.3 ASH (WT %): 0.026(PETRO-CAN 72)

15.4 SALT (lb/1000 bbl): 3(PETRO-CAN 72)

15.5 WATER (VOL %): 0.5(PETRO-CAN 72)

15.6 METALS (PPM): VANADIUM: 127(PETRO-CAN 72)
NICKEL: 12(PETRO-CAN 72

15.7 SULPHUR (WT %): 1.41(PETRO-CAN 72)

15.8 H2S (WT %): NIL(PETRO-CAN 72)

15.9 WAX (WT %): 5.9(PETRO-CAN 72)

15.10 YIELD ON CRUDE:

		WT %	VOL %
GAS		0.34	0.48
BUT. GASOLINE	TO 149 deg C	11.22	13.62
KEROSINE	149-232 deg C	11.21	12.38
GAS OIL	232-343 deg C	19.16	19.76
RESIDUE	above 343 deg C	58.07	53.76

(PETRO-CAN 72)

1.0 TYPE: LA ROSA CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 25.3(NELSON 69)

4.0 DENSITY (g/ml):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	0.923(MACKAY 82A)		
5	0.921(MACKAY 82A)		
10	0.917(MACKAY 82A)		
15	0.914(MACKAY 82A)		
20	0.911(MACKAY 82A)		
25	0.908(MACKAY 82A)		

NOTE: DEN = 0.923 - 0.000617 T
WHERE: DEN IS THE DENSITY OF FRESH OIL AT T (g/ml)
T IS OIL TEMPERATURE (DEG C)(MACKAY 82A)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (%)		
	0	..	..
0	640(MACKAY 82A)		
5	423(MACKAY 82A)		
10	282(MACKAY 82A)		
15	180(MACKAY 82A)		
20	135(MACKAY 82A)		
25	104(MACKAY 82A)		

NOTE: VISC = exp((6040/(T+273)) - 15.7)
WHERE: VISC IS THE VISCOSITY OF FRESH OIL AT T (mPa.s)
T IS OIL TEMPERATURE (DEG C) (MACKAY 82A)

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (%)		
	0	..	..
0	693(MACKAY 82A)		
5	459(MACKAY 82A)		
10	308(MACKAY 82A)		
15	197(MACKAY 82A)		
20	148(MACKAY 82A)		
25	115(MACKAY 82A)		

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -30(MACKAY 82A)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 PARAFFINS (WT %): 66.1(MACKAY 82A)

15.2 AROMATICS (WT %): 23.2(MACKAY 82A)

15.3 WAX (WT %): 9.90(MACKAY 82A)

15.4 ASPHALTENES (WT %): 6.23(MACKAY 82A)

15.5 SULPHUR (WT %): 1.76(NELSON 69)

1.0 TYPE: IPPL LIGHT SOUR BLEND.
BLEND OF LIGHT, MODERATELY LOW SULPHUR CRUDES FROM FIELDS IN SASKATCHEWAN. SAMPLE FROM PIPELINE BLEND DELIVERED TO TRAFALGAR REFINERY, SEPTEMBER 1970.

2.0 COLOUR:

3.0 API GRAVITY: 35.9(PETRO-CAN 70)

4.0 DENSITY (g/ml): @ 20 deg C, 0.8415(PETRO-CAN 70)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):
@ 21 deg C, 6.80(PETRO-CAN 70)
@ 38 deg C, 4.13(PETRO-CAN 70)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -12(PETRO-CAN 70)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 CARBON RESIDUE (WT %): 2.9(PETRO-CAN 70)

15.2 ASPHALTENES (WT %): 1.0 (PETRO-CAN 70)

15.3 METALS (PPM): VANADIUM: 7(PETRO-CAN 70)
NICKEL: 5(PETRO-CAN 70)

15.4 SULPHUR (WT %): 1.0(PETRO-CAN 70)

15.5 WATER (WT %): <0.01(PETRO-CAN 70)

15.6 H2S (WT %): 0.02(PETRO-CAN 70)

15.7 WAX (WT %): 6.2(PETRO-CAN 70)

15.8 YIELD ON CRUDE:

		WT %	VOL %
GAS		0.95	1.20
BUT. GASOLINE	TO 149 deg C	21.40	24.95
KEROSINE	149-232 deg C	14.80	15.60
GAS OIL	232-343 deg C	21.20	20.95
RESIDUE	above 343 deg C	41.65	37.30

(PETRO -CAN 70)

1.0 TYPE: LLOYDMINSTER CRUDE OIL, ALBERTA AND SASKATCHEWAN.
TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 20.7(AALUND 83A)

4.0 DENSITY (g/ml): @ 21 DEG C, 0.9289(AALUND 83A)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt): @ 40 DEG C,
101.00(AALUND 83A)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -32.0(AALUND 83A)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa): 30.3(AALUND 83A)

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 SULFUR (PPM): 31,500(AALUND 83A)

15.2 CON. CARBON (WT %): 9.18(AALUND 83A)

15.3 METALS (PPM): NICKEL: 52.70(AALUND 83A)
VANADIUM: 10.50(AALUND 83A)

1.0 TYPE: LLOYDMINSTER CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 16.2(NELSON 69)

4.0 DENSITY (g/ml):

TEMP (DEG C)	WEATHERING (WT %) 0	10	20
0	0.910 (MACKAY 82A)		
5	0.908 (MACKAY 82A)		
10	0.906 (MACKAY 82A)		
15	0.902 (MACKAY 82A)		
20	0.900 (MACKAY 82A)	0.923 (MACKAY 82A)	0.937 (MACKAY 82A)
25	0.897 (MACKAY 82A)		

NOTES: 0.90 @ ROOM TEMP (TWARDUS 80)

DEN = 0.910 - 0.00053 T
WHERE: DEN IS DENSITY OF FRESH OIL AT T (g/ml)
T IS OIL TEMPERATURE (DEG C) (MACKAY 82A)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP	WEATHERING (%)		
(DEG C)	0	..	..
0	180(MACKAY 82A) 126(TWARDUS 80)		
5	113(MACKAY 82A)		
10	80.1(MACKAY 82A) 86.1(TWARDUS 80)		
15	62.7(MACKAY 82A)		
20	47.6(MACKAY 82A) 52.3(TWARDUS 80)		
25	35.6(MACKAY 82A)		

NOTES: VISC = EXP((5100/(T+273)) - 13.6)
WHERE: VISC IS THE VISCOSITY OF FRESH OIL AT T (mPa.s)
EXP IS EXPONENTIAL BASE e
T IS OIL TEMPERATURE (DEG C)

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP	WEATHERING (%)		
(DEG C)	0	..	..
0	198(MACKAY 82A)		
5	124(MACKAY 82A)		
10	88.4(MACKAY 82A)		
15	69.5(MACKAY 82A)		
20	52.9(MACKAY 82A)		
25	39.7(MACKAY 82A)		

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm): 25 @ ROOM TEMP(TWARDUS 80)

6.2 OIL-WATER (mN/m or dynes/cm): 31.2 @ ROOM TEMP (TWARDUS 80)

7.0 POUR POINT (DEG C):

WEATHERING (WT %)	POUR POINT (DEG C)
0	-36(MACKAY 82A) -52(TWARDUS 80)
10	-36(MACKAY 82A)
20	-21(MACKAY 82A)

8.0 FLASH POINT (DEG C): 11(O.C.)(TWARDUS 80)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)
0	40(TWARDUS 80)
10	110(TWARDUS 80)
20	190(TWARDUS 80)
30	760(TWARDUS 80)
40	290(TWARDUS 80)
50	335(TWARDUS 80)
60	345(TWARDUS 80)
70	356(TWARDUS 80)
80	371(TWARDUS 80)
90	380(TWARDUS 80)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 IN-SITY COMBUSTION OF FRESH OIL: EASILY IGNITED, 6.1 VOL% RESIDUE(TWARDUS 80)

15.2 FIRE POINT (DEG C): 17(TWARDUS 80)

15.3 PARAFFINS (WT %):

WEATHERING (WT %)	PARAFFINS (WT %)
0	68.4(MACKAY 82A)
10	66.0(MACKAY 82A)
20	62.7(MACKAY 82A)

15.4 AROMATICS (WT %):

WEATHERING (WT %)	AROMATICS (WT %)
0	22.3(MACKAY 82A)
10	22.2(MACKAY 82A)
20	24.0(MACKAY 82A)

15.5 WAX (WT %):

WEATHERING (WT %)	WAX (WT %)
0	5.47(MACKAY 82A)
10	9.36(MACKAY 82A)
20	11.1(MACKAY 82A)

15.6 ASPHALTENES (WT %):

WEATHERING (WT %)	ASPHALTENES (WT %)
0	5.58(MACKAY 82A)
10	8.68(MACKAY 82A)
20	9.87(MACKAY 82A)

1.0 TYPE: MAYA CRUDE OIL, MEXICO.
SAMPLE FROM CANTARELL COMPLEX, GULF OF CAMPECHE.
SAMPLE RECEIVED AUGUST 1980 FROM ASHLAND OIL, INC.

2.0 COLOUR:

3.0 API GRAVITY: 21.7(PETRO-CAN 81)

4.0 DENSITY (g/ml): @ 15 deg C, 0.923(PETRO-CAN 81)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):
@ 10 deg C, 522(PETRO-CAN 81)
@ 20 deg C, 267(PETRO-CAN 81)
@ 40 deg C, 69.8(PETRO-CAN 81)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -15(PETRO-CAN 81)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 CARBON RESIDUE (WT %): 11.6(PETRO-CAN 81)

15.2 ASPHALTENES (WT %): 8.5 (PETRO-CAN 81)

15.3 METALS (PPM):VANADIUM: 271(PETRO-CAN 81)
NICKEL: 53(PETRO-CAN 81)

15.4 SULPHUR (WT %): 3.40(PETRO-CAN 81)

15.5 H2S (WT %): NIL(PETRO-CAN 81)

15.6 WAX (WT %): 2(PETRO-CAN 81)

15.7 YIELD ON CRUDE:

	WT %	VOL %
GAS	0.8	0.9
BUT. GASOLINE TO 149 deg C	9.65	12.45
KEROSINE 149-232 deg C	9.75	11.35
GAS OIL 232-343 deg C	14.65	15.75
RESIDUE above 343 deg C	65.15	59.55

(PETRO-CAN 81)

1.0 TYPE: MAYOGIAK CRUDE OIL, BEAUFORT SEA. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml):

For $F < 12$ % & T at 20 deg C:
$DEN = 0.863686 + 0.001809 F$
where: DEN is density of oil at T and F (g/mL)
F is percent of oil weathered
T is oil temperature (deg C)

TEMP (DEG C)	WEATHERING (%) 0	4	12
20	0.8625 (ENGELHARDT 84)	0.8727 (ENGELHARDT 84)	0.8848 (ENGELHARDT 84)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (%) 0	4	12
-10	752.1 (ENGELHARDT 84)	1023 (ENGELHARDT 84)	D.F. (ENGELHARDT 84)
0	67.27 (ENGELHARDT 84)	98.35 (ENGELHARDT 84)	414.3 (ENGELHARDT 84)
15	17.04 (ENGELHARDT 84)	29.88 (ENGELHARDT 84)	56.37 (ENGELHARDT 84)
25	9.702 (ENGELHARDT 84)	18.33 (ENGELHARDT 84)	30.41 (ENGELHARDT 84)

NOTE: D.F.- DID NOT FLOW

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C):

WEATHERING (%)	POUR POINT (DEG C)
0	-30(ENGELHARDT 84)
4	-26(ENGELHARDT 84)
12	-18(ENGELHARDT 84)

8.0 FLASH POINT (DEG C):

WEATHERING (%)	FLASH POINT (DEG C)
0	-12(ENGELHARDT 84)
4	47(ENGELHARDT 84)
12	66(ENGELHARDT 84)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA (DEG C):

PERCENT CONDENSED (VOL %)	WEATHERING (%)		
	0	4	12
INITIAL	-2 (ENGELHARDT 84)	55 (ENGELHARDT 84)	146 (ENGELHARDT 84)
50	318 (ENGELHARDT 84)	336 (ENGELHARDT 84)	376 (ENGELHARDT 84)
FINAL	555 (ENGELHARDT 84)	554 (ENGELHARDT 84)	558 (ENGELHARDT 84)
FINAL VOL CONT'D	94 % (ENGELHARDT 84)	88 % (ENGELHARDT 84)	83 % (ENGELHARDT 84)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 FIRE POINT:

WEATHERING (%)	FIRE POINT (DEG C)
0	-12(ENGELHARDT 84)
4	64(ENGELHARDT 84)
12	76(ENGELHARDT 84)

1.0 TYPE: MENEMOTA'82 CRUDE OIL.

2.0 COLOUR:

3.0 API GRAVITY: 19.7(PETRO-CAN 82)

4.0 DENSITY (g/ml): @ 15 deg C, 0.936(PETRO-CAN 82)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):
@ 40 deg C, 91.7(PETRO-CAN 82)
@ 100 deg C, 13.1(PETRO-CAN 82)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): <-30(PETRO-CAN 82)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa): <0.15(PETRO-CAN 82)

10.0 ASTM DISTILLATION DATA:

	deg C
IBP	62
10% vol. recovered at	180
20% vol. recovered at	255

VOL % RECOVERED AT	deg C
2.0	100
7.0	150
12.5	200
19.0	250
29.0	300

(ASTM D 86)(PETRO-CAN 82)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 ASPHALTENES (WT %): 5.7 (PETRO-CAN 82)

15.2 ASH (WT %): 0.07(PETRO-CAN 82)

15.3 METALS (PPM): VANADIUM: 390(PETRO-CAN 82)
NICKEL: 49(PETRO-CAN 82)
SODIUM: 1(PETRO-CAN 82)
IRON: <1(PETRO-CAN 82)
COPPER: <1(PETRO-CAN 82)
CHROMIUM: 0(PETRO-CAN 82)

15.4 SULPHUR (WT %): 2.32(PETRO-CAN 82)

15.5 H2S (WT %): <1(PETRO-CAN 82)

15.6 WAX (WT %): 2.51(PETRO-CAN 82)
CONGEALING POINT OF WAX (deg C): 58.5(PETRO-CAN 82)

15.7 ACID NUMBER (mgKOH/g): 1.03(PETRO-CAN 82)

15.8 UOP K CHARACTERIZATION FACTOR: 11.7(PETRO-CAN 82)

15.9 YIELD ON CRUDE:

		WT %	VOL %
STRAIGHT-RUN GASOLINE UP TO 65 deg C		1.78	2.64
NAPHTHA	65-150 deg C	5.70	7.15
KEROSINE	150-250 deg C	10.46	11.88
GAS OIL	250-370 deg C	18.28	19.07
RESIDUE	above 370 deg C	63.79	59.26

(PETRO-CAN 82)

1.0 TYPE: IPPL MIXED SOUR BLEND.
BLEND OF LIGHT, MODERATELY LOW SULPHUR CRUDE
FROM FIELDS IN ALBERTA AND SASKATCHEWAN
SAMPLE FROM PIPELINE BLEND DELIVERED TO
TRAFALGAR REFINERY, DECEMBER 1974.

2.0 COLOUR:

3.0 API GRAVITY: 38.6(PETRO-CAN 75)

4.0 DENSITY (g/ml): @ 20 deg C, 0.828(PETRO-CAN 75)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -6(PETRO-CAN 75)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 CARBON RESIDUE (WT %): 1.9(PETRO-CAN 75)

15.2 ASPHALTENES (WT %): 0.3 (PETRO-CAN 75)

15.3 METALS: VANADIUM: <2(PETRO-CAN 75)
NICKEL: 2(PETRO-CAN 75)

15.4 SULPHUR (WT %): 0.46(PETRO-CAN 75)

15.5 WATER (WT %): NIL(PETRO-CAN 75)

15.6 YIELD ON CRUDE:

		WT %	VOL %
GAS		1.0	1.55
BUT. GASOLINE	TO 149 deg C	19.55	22.45
KEROSINE	149-232 deg C	16.1	16.85
GAS OIL	232-343 deg C	21.65	21.35
RESIDUE	above 343 deg C	41.7	37.8

(PETRO-CAN 75)

1.0 TYPE: MURBAN CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml):

TEMP (DEG C)	WEATHERING (WT %) 0	10	20
0	0.838 (MACKAY 82A)		
5	0.832 (MACKAY 82A)		
10	0.830 (MACKAY 82A)		
15	0.828 (MACKAY 82A)		
20	0.824 (MACKAY 82A)	0.842 (MACKAY 82A)	0.855 (MACKAY 82A)
25	0.822 (MACKAY 82A)		

NOTES: DEN = 0.837 - 0.000606 T
WHERE: DEN IS OIL DENSITY OF AT T (g/ml)
T IS OIL TEMPERATURE (DEG C) (MACKAY 82A)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP	WEATHERING (%)		
(DEG C)	0	..	..
0	40.1(MACKAY 82A)		
5	22.1(MACKAY 82A)		
10	11.9(MACKAY 82A)		
15	6.97(MACKAY 82A)		
20	4.37(MACKAY 82A)		
25	3.90(MACKAY 82A)		

NOTES: VISC = EXP((7960/(T+273)) - 25.6)
WHERE: VISC IS THE VISCOSITY OF FRESH OIL AT T (mPa.s)
EXP IS EXPONENTIAL BASE e
T IS OIL TEMPERATURE (DEG C) (MACKAY 82A)

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP	WEATHERING (%)		
(DEG C)	0	..	..
0	47.9(MACKAY 82A)		
5	26.6(MACKAY 82A)		
10	14.3(MACKAY 82A)		
15	8.42(MACKAY 82A)		
20	5.30(MACKAY 82A)		
25	4.74(MACKAY 82A)		

6.0 INTERFACIAL TENSIONS:

6.1 OIL-SEAWATER (mN/m or dynes/cm): @ ? TEMP: 16.3;
16.4 @ 10 WT % WEATHERING;
14.3 @ 20 WT % WEATHERING(MACKAY 82A)

7.0 POUR POINT (DEG C):

WEATHERING (WT %)	POUR POINT (DEG C)
0	-3(MACKAY 82A)
10	0(MACKAY 82A)
20	15(MACKAY 82A)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILTY:

15.0 OTHERS:

15.1 PARAFFINS (WT%):

WEATHERING (WT %)	PARAFFINS (WT %)
0	81.4(MACKAY 82A)
10	76.3(MACKAY 82A)
20	74.3(MACKAY 82A)

15.2 AROMATICS (WT %):

WEATHERING (WT %)	AROMATICS (WT %)
0	16.6(MACKAY 82A)
10	17.5(MACKAY 82A)
20	19.4(MACKAY 82A)

15.3 WAX (WT %):

WEATHERING (WT %)	WAX (WT %)
0	5.68(MACKAY 82A)
10	6.83(MACKAY 82A)
20	7.45(MACKAY 82A)

15.4 ASPHALTENES (WT %):

WEATHERING (WT %)	ASPHALTENES (WT %)
0	0.75(MACKAY 82A)
10	4.14(MACKAY 82A)
20	4.20(MACKAY 82A)

15.5 AQUEOUS SOLUBILITY (mg/L): @ ROOM TEMP, 28.62 (BOBRA 83)

1.0 TYPE: NEKTORALIK K-59 CRUDE OIL, BEAUFORT SEA.
TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 26.1(DOME 84)

4.0 DENSITY (g/ml): @ 15.6 DEG C, 0.8541(DOME 84)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (%) 0	..	..
10	21(DOME 84)		
20	12.90(DOME 84)		
30	9.80(DOME 84)		
40	6.78(DOME 84)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): 2.8(DOME 84)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)
5	121(DOME 84)
10	160(DOME 84)
15	198(DOME 84)
20	238(DOME 84)
25	254(DOME 84)
30	277(DOME 84)
35	287(DOME 84)
40	298(DOME 84)
45	304(DOME 84)
50	312(DOME 84)
55	321(DOME 84)
60	338(DOME 84)
65	342(DOME 84)
70	343(DOME 84)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILTY:

15.0 OTHERS:

15.1 TOTAL SULFUR (WT %): 0.17(DOME 84)

15.2 TOTAL SALTS (g/m^3): 0.5992(DOME 84)

1.0 TYPE: NEKTORALIK K-59A CRUDE OIL, BEAUFORT SEA.
TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 39.9(DOME 84)

4.0 DENSITY (g/ml): @ ? TEMP, 0.8257(DOME 84)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (%) 0	..	..
20	1.396(DOME 84)		
30	1.205(DOME 84)		
40	1.020(DOME 84)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (%) 0	..	..
20	1.695(DOME 84)		
30	1.475(DOME 84)		
40	1.260(DOME 84)		

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -39(DOME 84)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)
5	90(DOME 84)
10	101(DOME 84)
15	111(DOME 84)
20	120(DOME 84)
25	131(DOME 84)
30	140(DOME 84)
35	153(DOME 84)
40	170(DOME 84)
45	186(DOME 84)
50	201(DOME 84)
55	217(DOME 84)
60	231(DOME 84)
65	243(DOME 84)
70	254(DOME 84)
75	267(DOME 84)
80	280(DOME 84)
85	294(DOME 84)
90	313(DOME 84)
95	323(DOME 84)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 TOTAL SULFUR (WT %): 0.0067(DOME 84)

15.2 TOTAL SALTS (g/m^3): 32.075(DOME 84)

1.0 TYPE: NERLERK M-98 CRUDE OIL, BEAUFORT SEA.
TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 22.3(DOME 84)

4.0 DENSITY (g/ml): @ 15.6 DEG C, 0.9227(DOME 84)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

	WEATHERING (%)		
TEMP (DEG C)	0	..	..
20	89.6(DOME 84)		
30	50.3(DOME 84)		
40	30.0(DOME 84)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C):

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

1.0 TYPE: NERLERK M-98B CRUDE OIL, BEAUFORT SEA.
TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 24.3(DOME 84)

4.0 DENSITY (g/ml): @ 15.6 DEG C, 0.9114(DOME 84)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (%) 0	..	..
20	54.3(DOME 84)		
30	30.6(DOME 84)		
40	19.4(DOME 84)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C):

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHRES:

1.0 TYPE: NERLERK M-98C CRUDE OIL, BEAUFORT SEA.
TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 26.4(DOME 84)

4.0 DENSITY (g/ml): @ 15.6 DEG C, 0.8981(DOME 84)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (%) 0	..	..
20	12.7(DOME 84)		
30	8.84(DOME 84)		
40	6.34(DOME 84)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C):

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

1.0 TYPE: NINIAN CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 37.0(LYNCH 81)

4.0 DENSITY (g/ml): @ 16 DEG C, 0.8393(LYNCH 81)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt): @ 50 DEG C, 7.5 (LYNCH 81)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): 6(LYNCH 81)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

WEIGHT PERCENT	TEMP (DEG C)
6.7	5 TO 100(LYNCH 81)
12.7	100 TO 160(LYNCH 81)
12.1	160 TO 250(LYNCH 81)
19.7	250 TO 350(LYNCH 81)
48.8	>350(LYNCH 81)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 WAX (WT %): 8(LYNCH 81)

15.2 ASPHALTENES (WT %): 0.5(LYNCH 81)(IP METHOD 143/57)

1.0 TYPE: NORMAN WELLS CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml):

For Fw < 20.4 % & T between 0 and 25 deg C:
DEN = 0.846161 + 0.001732 Fw - 0.000783 T
where: DEN is density of oil at T and Fw (g/ml)
Fw is weight percent of oil weathered
T is oil temperature (deg C)

	WEATHERING (WT %)		
TEMP (DEG C)	0	12	20.4
0	0.845 (MACKAY 82A) 0.840 (MACKAY 75) 0.8581 (EETD 85)	0.864 (MACKAY 75)	0.881 (MACKAY 75)
5	0.841 (MACKAY 82A)		
10	0.839 (MACKAY 82A)		
15	0.832 (EETD 84) 0.834 (MACKAY 82A) 0.832 (MACKAY 75)	0.855 (MACKAY 75)	0.873 (MACKAY 75)
20	0.832 (MACKAY 82A)		
25	0.829 (MACKAY 82A)	0.844 (MACKAY 75)	0.863 (MACKAY 75)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

VISC = exp(2.26 - 2461.7 T/(273(T+273)))
where: VISC is dynamic viscosity of oil at T (mPa.s)
exp is exponential base e
T is oil temperature (deg C)

TEMP (DEG C)	WEATHERING (WT %) 0	20.4	42.3
-25	22(MACKAY 75)	99(MACKAY 75)	
-15	18(MACKAY 75)	69(MACKAY 75)	
0	8.76(MACKAY 82A) 14.2(TWARDUS 80) 11(MACKAY 75)	40(MACKAY 75)	300(MACKAY 75)
5	7.11(MACKAY 82A)		
10	5.81(MACKAY 82A) 8.68(TWARDUS 80) 9(MACKAY 75)	28(MACKAY 75)	180(MACKAY 75)
15	5.05(MACKAY 82A) 7.9(MACKAY 75)	25(MACKAY 75)	150(MACKAY 75)
20	4.39(MACKAY 82A) 5.9(TWARDUS 80)		
25	3.93(MACKAY 82A) 6.1(MACKAY 75)	15(MACKAY 75)	80(MACKAY 75)

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (WT %)		
	0	20.4	42.3
0	10.37(MACKAY 82A) 13.1(MACKAY 75)	46(MACKAY 75)	34(MACKAY 75)
5	8.45(MACKAY 82A)		
10	6.93(MACKAY 82A)		
15	6.06(MACKAY 82A) 9.5(MACKAY 75)	29(MACKAY 75)	172(MACKAY 75)
20	5.28(MACKAY 82A)		
25	4.74(MACKAY 82A)	18(MACKAY 75)	93(MACKAY 75)

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (%)		
	0	20.4	36.7
0	24.9(EETD 84)		
5	23.7(MACKAY 75)	28.2(MACKAY 75)	29.8(MACKAY 75)
15	23.6(EETD 84)		
25	22.7(MACKAY 75)	27(MACKAY 75)	28.5(MACKAY 75)

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (%)		
	0	..	..
0	16.5(EETD 84)		
15	16.4(EETD 84)		

6.3 OIL-WATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	20.5(EETD 85)		
15	20.1(EETD 85)		

7.0 POUR POINT (DEG C):

WEATHERING (WT %)	POUR POINT (DEG C)
0	<-50(MACKAY 82A) -85(TWARDUS 80) -50(MACKAY 75)
10	<-50(MACKAY 82A)
12	-34(MACKAY 75)
20	<-50(MACKAY 82A)
20.4	-26(MACKAY 75)
36.7	-12(MACKAY 75)

NOTES: Pour Point = -51 + 1.50 E - 0.012 E**2
WHERE: E = WT % EVAPORATED (MACKAY 75)

8.0 FLASH POINT (DEG C): 3(C.C.)(EETD 84)

9.0 VAPOUR PRESSURE (kPa): 36.2(EETD 84)

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)
0	60(MACKAY 75)
10	118(MACKAY 75)
20	145(MACKAY 75)
30	174(MACKAY 75)
40	223(MACKAY 75)
50	280(MACKAY 75)

DATA OBTAINED FROM A CURVE(MACKAY 75)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (%)		
	0	..	..
0	0(EETD 84)		
15	0(EETD 84)		

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (%)		
	0	..	..
0	0(EETD 84)		
15	0(EETD 84)		

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (%)		
	0	..	..
0	N/A(EETD 84)		
15	N/A(EETD 84)		

12.0 WEATHERING:

$$Fv = \frac{\ln(1 + 5315.8\ O \exp(6.3 - 3911.9/TK)/TK)}{(5315.8/TK)}$$

where: Fv is fraction of oil weathered by volume
ln is natural log
O is evaporation exposure
exp is exponential base e
TK is environmental temperature
(Kelvin, K = deg C + 273)

(EETD 84)

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP	WEATHERING (%)		
(DEG C)	0	..	..
0	29.8(EETD 84)		
15	29.2(EETD 84)		

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILITY (% DISPERSED):

OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP	WEATHERING (%)		
(DEG C)	0	..	..
0	79(EETD 85)		
15	75(EETD 85)		

14.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP	WEATHERING (%)		
(DEG C)	0	..	..
0	5(EETD 85)		
15	8(EETD 85)		

15.0 OTHERS:

15.1 FIRE POINT (DEG C): <13.5 (TWARDUS 80)

15.2 AQUEOUS SOLUBILITY (mg/L):

WEATHERING (WT %)	SOLUBILITY (mg/L)
0	32.3(MACKAY 75) 32.3(BOBRA 83)
6	23.18(MACKAY 75) 27.0(BOBRA 83)
12	14.59(MACKAY 75) 14.6(BOBRA 83)
20.4	7.33(MACKAY 75) 7.3(BOBRA 83)
29	2.27(MACKAY 75)
36	0.68(BOBRA 83)
43.2	0.14(BOBRA 83)

15.3 PARAFFINS (WT %):

WEATHERING (WT %)	PARAFFINS (WT %)
0	85.1(MACKAY 82A)
10	82.2(MACKAY 82A)
20	80.0(MACKAY 82A)

15.4 AROMATICS (WT %):

WEATHERING (WT %)	AROMATICS (WT %)
0	11.4(MACKAY 82A)
10	11.5(MACKAY 82A)
20	13.1(MACKAY 82A)

15.5 WAX (WT %):

WEATHERING (WT %)	WAX (WT %)
0	1.76(MACKAY 82A)
10	2.29(MACKAY 82A)
20	1.90(MACKAY 82A)

15.6 ASPHALTENES (WT %):

WEATHERING (WT %)	ASPHALTENES (WT %)
0	1.13(MACKAY 82A)
10	2.88(MACKAY 82A)
20	3.20(MACKAY 82A)

1.0 TYPE: NORTH SLOPE CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 26.8(API 81)

4.0 DENSITY (g/ml): @ 15.5 DEG C, 0.893(API 81)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C):

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)
5	98(API 81)
10	131(API 81)
15	161(API 81)
20	193(API 81)
25	216(API 81)
30	241(API 81)
35	262(API 81)
40	282(API 81)
45	301(API 81)
50	323(API 81)
55	342(API 81)
60	361(API 81)
65	380(API 81)
70	400(API 81)
75	419(API 81)
80	439(API 81)
85	461(API 81)
90	484(API 81)
95	511(API 81)
FBP	539(API 81)

NOTE: (API 81) DATA FROM SIMULATED DISTILLATION ASTM METHOD D 2887

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWTER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 SULFUR (WT %): 1.04(API 81)

15.2 NITROGEN (WT %): 0.20(API 81)

15.3 METALS (PPM): NICKEL: 21(API 81)
VANADIUM: 9.4 TO 9.7(API 81)

1.0 TYPE: PIPER CRUDE OIL, NORTH SEA. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 35.2(HMSO 76)

4.0 DENSITY (g/ml): @ 15 DEG C, 0.849(HMSO 76)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt): @ 50 DEG C, 3.55(HMSO 76)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -9 (-3)(HMSO 76)
NOTE: FIGURES IN BRACKETS ARE OBTAINED FROM THE OIL INDUSTRY AND ARE THOSE WHICH DO NOT AGREE WITH THE PUBLISHED DATA (HMSO 76)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

WEIGHT PERCENT	TEMP (DEG C)
8.4,(8.3)	5 TO 100(HMSO 76)
17.6,(12.1)	100 TO 160(HMSO 76)
11.9,(12.9)	160 TO 250(HMSO 76)
17.9,(18.7)	250 TO 350(HMSO 76)
44.2,(48)	>350(HMSO 76)

NOTE: FIGURES IN BRACKETS ARE OBTAINED FROM THE OIL INDUSTRY AND ARE THOSE WHICH DO NOT AGREE WITH THE PUPLISHED DATA.(HMSO 76)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICICENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 SULFUR (WT %): 0.92(HMSO 76)

15.2 WAX (WT %): 4(HMSO 76)

1.0 TYPE: SHELL SPECIAL PRIMER ASPHALT.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/mL):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	0.9526(EETD 85)		
15	0.9421(EETD 85)		

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	3280(EETD 85)		
15			

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0			
15			

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	28.8(EETD 85)		
15	28.3(EETD 85)		

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	26.8(EETD 85)		
15	24.7(EETD 85)		

6.3 OIL-WATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	28.9(EETD 85)		
15	27.8(EETD 85)		

7.0 POUR POINT (DEG C): -17(EETD 85)

8.0 FLASH POINT (DEG C): 16(C.C.)(EETD 85)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	0(EETD 85)		
15	1.0(EETD 85)		

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	0(EETD 85)		
15	1.0(EETD 85)		

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	N/A(EETD 85)		
15	55.1(EETD 85)		

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	15.6(EETD 85)		
15	16.2(EETD 85)		

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILITY (% DISPERSED):

OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	7(EETD 85)		
15	37(EETD 85)		

14.2 NATURAL DISPERSIBILITY:

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	0(EETD 85)		
15	0(EETD 85)		

15.0 OTHERS:

1.0 TYPE: PRUDHOE BAY CRUDE OIL. TYPICAL DATA

2.0 COLOUR: BROWNISH BLACK(USCG 72)

3.0 API GRAVITY: 27.0(USCG 72)

4.0 DENSITY (g/ml):

For Fw < 24.1 % and T between 0 and 25 deg. C:
DEN = 0.913841 + 0.001582 Fw - 0.000955 T
where: DEN is density of oil at T and Fw (g/ml)
Fw is weight percent of oil weathered
T is oil temperature (deg C)

	WEATHERING (WT %)				
TEMP (DEG C)	0	7.3	9.8	11.2	24.1
0	0.915 (MACKAY 82A) 0.909 (MACKAY 82B)				
5	0.911 (MACKAY 82A) 0.906 (MACKAY 75)		0.925 (MACKAY 75)		0.950 (MACKAY 75)
10	0.910 (MACKAY 82A)				
15	0.905 (MACKAY 82A) 0.899 (MACKAY 75)		0.916 (MACKAY 75)		0.937 (MACKAY 75)
20	0.902 (MACKAY 82A) 0.901 (MACKAY 82A) 0.884 (MACKAY 80A) 0.881 (USCG 71)	0.902 (MACKAY 82A)		0.910 (MACKAY 80A)	
25	0.900 (MACKAY 82A) 0.888 (MACKAY 75)		0.905 (MACKAY 75)		0.928 (MACKAY 75)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (WT %)				
	0	7.3	9.8	11.2	24.1
-20	180 (MACKAY 75)		540 (MACKAY 75)		3700 (MACKAY 75)
-15	135 (MACKAY 75)		420 (MACKAY 75)		4000 (MACKAY 75)
- 8	1000 (MARTIN 77)				
- 2	170 (MARTIN 77)				
0	577 (MACKAY 82A)		205 (MACKAY 75)		1700 (MACKAY 75)
	500 (MACKAY 82B)				
	50 (MACKAY 80A)	108 (MACKAY 80A)		204 (MACKAY 80A)	
	19 (MARTIN 77)				
	68 (MACKAY 75)				
5	196 (MACKAY 82A)				
	140 (USCG 71)				
10	103 (MACKAY 82A)				
	80 (USCG 71)				
	96 (MACKAY 82B)				
15	68.4 (MACKAY 82A)		102 (MACKAY 75)		820 (MACKAY 75)
	26 (MACKAY 80A)	62 (MACKAY 80A)		105 (MACKAY 80A)	
	33 (MACKAY 75)				
	50 (USCG 71)				

5.1 DYNAMIC VISCOSITY (mPa.s or cp) (Cont'd):

TEMP (DEG C)	WEATHERING (WT %)				
	0	7.3	9.8	11.2	24.1
20	45.7 (MACKAY 82A) 34.9 (MACKAY 82B)				
25	35.3 (MACKAY 82A) 17 (MACKAY 80) 20 (MACKAY 75)	37 (MACKAY 80A)	55 (MACKAY 75)	61 (MACKAY 80A)	400 (MACKAY 75)

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (WT %)		
	0	9.8	24.1
0	630 (MACKAY 82A)		
5	216 (MACKAY 82A)		
10	113 (MACKAY 82A)		
15	75.5 (MACKAY 82A) 37 (MACKAY 75)	111 (MACKAY 75)	878 (MACKAY 75)
20	50.7 (MACKAY 82A)		
25	39.2 (MACKAY 82A) 23 (MACKAY 75)	61 (MACKAY 75)	431 (MACKAY 75)

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

-SURFACE TENSION = 30.0 (1 + F)
WHERE: F = VOL FRACTION EVAPORATED (MACKAY 82B),

-@ 0 DEG C: 30.4(EETD 85)
-@ 15 DEG C: 28.3(EETD 85)
-@ 20 DEG C: 30.1(MACKAY 82B)

6.2 OIL-SEAWATER (mN/m or dynes/cm):

-INTERFACIAL TENSION = 27.0 (1 + 2.0 F)
WHERE: F = VOL FRACTION EVAPORATED (MACKAY 82B),

-@ 0 DEG C: 15.0(EETD 85)
-@ ? TEMP: 14.8(MACKAY 82A)
-@ 15 DEG C: 9.7(EETD 85)
-@ 20 DEG C: 27.0(MACKAY 82B)

6.3 OIL-WATER (mN/m or dynes/cm):

-@ 0 DEG C: 17.6(EETD 85)
-@ 15 DEG C: 16.9(EETD 85)

7.0 POUR POINT (DEG C):

WEATHERING (WT %)	POUR POINT (DEG C)
0	0(MACKAY 82A) -27(MACKAY 80) -9.5(MARTIN 77) -42(MACKAY 75) -9.1(USCG 72) -2(MACKAY 82B)
7.3	-16(MACKAY 80)
9.8	-27(MACKAY 75)
11.2	-3(MACKAY 80)
18.2	-18(MACKAY 75)
24.1	-11(MACKAY 75)

8.0 FLASH POINT (DEG C):

WEATHERING (WT %)	FLASH POINT (DEG C)
0	30(O.C.)(MACKAY 80)
7.3	71(O.C.)(MACKAY 80)
11.2	84(O.C.)(MACKAY 80)

NOTES: FLASH POINT = 70.0 (1 + 3.7 F)
WHERE: F = VOL FRACTION EVAPORATED (MACKAY 82B)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)
0	50(MACKAY 75)
10	168(MACKAY 75)
20	235(MACKAY 75)
30	290(MACKAY 75)
40	328(MACKAY 75)

DATA OBTAINED FROM A CURVE(MACKAY 75)

INITIAL BOILING POINT: 67(MACKAY 80)

11.0 EMULSION FORMATION TENDENCY & STABILITY: FORMS FAIRLY STABLE EMULSION(MACKAY 82B)

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (WT %)
	0
0	25.8(EETD 85)
15	31.2(EETD 85)

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 FIRE POINT (DEG C):

WEATHERING (WT %)	FIRE POINT (DEG C)
0	35(MACKAY 80)
7.3	86(MACKAY 80)
11.2	91(MACKAY 80)

15.2 AQUEOUS SOLUBILITY (mg/L):

WEATHERING (WT %)	AQUEOUS SOLUBILITY (mg/L)
0	41.7(MACKAY 80) 29.25(MACKAY 75) 29.3(BOBRA 83) 29.2 @ 20 DEG C(MACKAY 82B)
7.3	15.0(MACKAY 80)
9.8	4.89(MACKAY 75) 4.91(BOBRA 83)
11.2	7.6(MACKAY 80)
18.2	0.153(BOBRA 83)
24.4	0.102(BOBRA 83)

NOTES: SOLUBILITY = 29.2 EXP(-12.0 Fv)
WHERE: Fv = VOL FRACTION EVAPORATED (MACKAY 82B)

15.3 INITIAL BOILING POINT (DEG C):

WEATHERING (WT %)	IBP (DEG C)
0	67(MACKAY 80)
7.3	102(MACKAY 80)
11.2	192(MACKAY 80)

15.4 PARAFFINS (WT %): 86.9(MACKAY 82A)

15.5 AROMATICS (WT %): 9.94(MACKAY 82A)

15.6 WAX (WT %): 3.86(MACKAY 82A)
WAX (MASS FRACTION) = 0.045 / (1 - F)
WHERE: F = VOL FRACTION EVAPORATED(MACKAY 82B)

15.7 ASPHALTENES (WT %): 1.53(MACKAY 82A)
ASPHALTENE (MASS FRACTION) = 0.024 / (1 - F)
WHERE: F = VOL FRACTION EVAPORATED(MACKAY 82B)

15.8 CARBON RESIDUE (WT %): 4.7 %(USCG 72)

15.9 SULPHUR (WT %): 0.82(USCG 72)

1.0 TYPE: RAINBOW LIGHT & MEDIUM CRUDE OIL, ALBERTA.
TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 40.7(AALUND 83A)

4.0 DENSITY (g/ml): @ 21 DEG C, 0.8210(AALUND 83A)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt): @ 40 DEG C, 3.77(AALUND 83A)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): 2.5(AALUND 83A)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa): 33.9(AALUND 83A)

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 SULFUR (PPM): 5,000(AALUND 83A)

15.2 CON. CARBON (WT %): 1.65(AALUND 83A)

15.3 METALS (PPM): NICKEL: 0.85(AALUND 83A)
VANADIUM: 0.50(AALUND 83A)

15.4 H2S (PPM): 10.2(AALUND 83A)

15.5 WAX (WT %): 20.40(AALUND 83A)

1.0 TYPE: RANGELAND-SOUTH L & M CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 39.5(AALUND 83A)

4.0 DENSITY (g/ml): @ 21 DEG C, 0.8267(AALUND 83A)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):
@40 Deg C, 2.67(AALUND 83A)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -40(AALUND 83A)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa): 39.3(AALUND 83A)

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 SULFUR (PPM): 7,520(AALUND 83A)

15.2 CON. CARBON (WT %): 0.69(AALUND 83A)

15.3 METALS (PPM): NICKEL: 1.20(AALUND 83A)
VANADIUM: 1.40(AALUND 83A)

15.4 H2S (PPM): 20.1(AALUND 83A)

15.5 WAX (WT %): 12.44(AALUND 83A)

1.0 TYPE: SABLE ISLAND LIQUID CONDENSATE. TYPICAL DATA.

2.0 COLOUR: CLEAR, PALE YELLOW(HUTCHESON 83)

3.0 API GRAVITY: 39.9(ROSS 82A)

4.0 DENSITY (g/ml):

For $F < 82$ % & T between 0 and 25 deg. C:
$DEN = 0.865048 + 0.000383 F - 0.000298 T$
where: DEN is density of oil at T and F (g/mL)
F is percent of oil weathered
T is oil temperature (deg C)

TEMP (DEG C)	WEATHERING (%) 0	41	71	82
0	0.878 (MACKAY 82A)			
5	0.834 (ROSS 82A) 0.876 (MACKAY 82A)	0.875 (ROSS 82A)	0.885 (ROSS 82A)	0.914 (ROSS 82A)
10	0.875 (MACKAY 82A)			
15	0.823 (ROSS 82A) 0.874 (MACKAY 82A)	0.869 (ROSS 82A)	0.870 (ROSS 82A)	0.899 (ROSS 82A)
20	0.872 (MACKAY 82A)			
25	0.869 (MACKAY 82A)			

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (%) 0	41	71	82
0	12.8 (MACKAY 82A)			
5	2.7 (ROSS 82A) 4.96 (MACKAY 82A)	88.0 (ROSS 82A)	2250 (ROSS 82A)	6600 (ROSS 82A)
10	3.39 (MACKAY 82A)			
15	2.02 (ROSS 82A) 2.96 (MACKAY 82A)	5.55 (ROSS 82A)	320 (ROSS 82A)	2450 (ROSS 82A)
20	2.67 (MACKAY 82A)			
25	2.41 (MACKAY 82A)			

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (%) 0	41	71	82
0	14.6 (MACKAY 82A)			
5	3.2 (ROSS 82A) 5.66 (MACKAY 82A)	100.6 (ROSS 82A)	2542 (ROSS 82A)	7221 (ROSS 82A)
10	3.87 (MACKAY 82A)			
15	2.45 (ROSS 82A) 3.39 (MACKAY 82A)	6.39 (ROSS 82A)	368 (ROSS 82A)	2725 (ROSS 82A)
20	3.06 (MACKAY 82A)			
25	2.77 (MACKAY 82A)			

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm): 28.5 @ ? TEMP (ROSS 82A)

6.2 OIL-SEAWATER (mN/m or dynes/cm):
29.6 @ ? TEMP (ROSS 82A),
18.4 @ ? TEMP (MACKAY 82A)

7.0 POUR POINT (DEG C):

WEATHERING (%)	POUR POINT (DEG C)
0	-22(ROSS 82A) 3(MACKAY 82A)
41	3(ROSS 82A)
71	18(ROSS 82A)
82	27(ROSS 82A)

8.0 FLASH POINT (DEG C):

WEATHERING (%)	FLASH POINT (DEG C)
0	16(O.C.)(ROSS 82A)
41	81(O.C.)(ROSS 82A)
71	135(O.C.)(ROSS 82A)
82	147(O.C.)(ROSS 82A)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

VOL FRACTION	TEMP (DEG C)
0.15	103(ROSS 82A)
0.30	123(ROSS 82A)
0.50	156(ROSS 82A)
0.70	220(ROSS 82A)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILITY: LITTLE TENDENCY TO DISPERSE AT 5C FOR FRESH AND 42% WEATHERED OIL(ROSS 82A)

15.0 OTHERS:

15.1 FIRE POINT (DEG C):

WEATHERING (%)	FIRE POINT (DEG C)
0	16(ROSS 82A)
41	84(ROSS 82A)
71	141(ROSS 82A)
82	161(ROSS 82A)

15.2 SOLUBILITY (mg/L):

DISSOLVED IN	WEATHERING (%) 0	42
DOUBLE DISTILLED WATER	58.08(ROSS 82A)	5.34(ROSS 82A)
SEAWATER	74.65(ROSS 82A)	8.02(ROSS 82A)

15.3 PARAFFINS (WT %): 81.07(ROSS 82A), 88.4(MACKAY 82A)

15.4 AROMATICS (WT %): 10.8(MACKAY 82A)

15.5 WAX (WT %): 2.01(MACKAY 82A)

15.6 ASPHALTENES (WT %): 0.60(MACKAY 82A)

15.7 H2S (PPM): 0(ROSS 82A)

15.9 TOXICITY:

NOTE: TOXICITY TESTS USED VENTURE FIELD CONDENSATE FROM INTERVALS 4678 TO 4691 m.

A) RAINBOW TROUT (15 C, WATER):
LC50: 5.6 uL/L @ 96 H & 6.0 uL/L @ 24 H
LTC: 5 uL/L
INCIPIENT LETHAL THRESHOLD CONC: 5 uL/L
ET50 (SWIMMING): < 1 H
EC50 (SWIMMING): <4.9 uL/L
(HUTCHESON 83)

B) GREEN SEA URCHIN (10 C, SEAWATER):
LTC: ABOUT 40.5 uL/L
INCAPACITATED ABOUT 3.8 uL/L
NO ACUTE OR DELAY MORTALITIES UP TO 33.5 uL/L AFTER 96H
DELAY MORTALITIES > OR = 33.5 uL/L
(HUTCHESON 83)

1.0 TYPE: SOUR BLEND CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml):

For T between 0 and 25 deg. C:
DEN = 0.856 - 0.00077 T
where: DEN is density of fresh oil at T (g/ml)
T is oil temperature (deg C)

TEMP (DEG C)	WEATHERING (WT %) 0	10	20
0	0.861 (EETD 84) 0.852 (MACKAY 82A)		
5	0.850 (MACKAY 82A)		
10	0.847 (MACKAY 82A)		
15	0.850 (EETD 84) 0.842 (MACKAY 82A)		
20	0.840 (MACKAY 82A)	0.861 (MACKAY 82A)	0.875 (MACKAY 82A)
25	0.836 (MACKAY 82A)		

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

VISC = exp(3.189 - 4691.9 T/(273(T+273)))
where: VISC is dynamic viscosity of fresh oil at T (mPa.s)
exp is exponential base e
T is oil temperature (deg C)

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	24.2(MACKAY 82A) 26.7(TWARDUS 80)		
5	16.9(MACKAY 82A)		
10	10.9(MACKAY 82A) 19.4(TWARDUS 80)		
15	8.20(MACKAY 82A)		
20	6.59(MACKAY 82A) 9.5(TWARDUS 80)		
25	5.95(MACKAY 82A)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	28.4(MACKAY 82A)		
5	19.9(MACKAY 82A)		
10	12.9(MACKAY 82A)		
15	9.74(MACKAY 82A)		
20	7.85(MACKAY 82A)		
25	7.12(MACKAY 82A)		

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (%) 0	..	..
15	25.8(EETD 84) 25.6(EETD 85)		

NOTES: @ ROOM TEMP: 24.1(TWARDUS 80)

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (%) 0	..	..
15	0.75(EETD 84)		

6.3 OIL-WATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (%) 0	..	..
15	13.0(EETD 85)		

NOTES: @ ROOM TEMP: 27.5 (TWARDUS 80)

7.0 POUR POINT (DEG C):

WEATHERING (WT %)	POUR POINT (DEG C)
0	6(MACKAY 82A) -50(TWARDUS 80)
10	6(MACKAY 82A)
20	9(MACKAY 82A)

8.0 FLASH POINT (DEG C): 6.6(C.C.)(EETD 84)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)	
IBP	45(TWARDUS 80)	114
5		140
10	95(TWARDUS 80)	164
15		188
20	130(TWARDUS 80)	213
25		239
30	180(TWARDUS 80)	264
40	235(TWARDUS 80)	(MODIFIED ASTM D 86)
50	300(TWARDUS 80)	(EETD 84)
60	345(TWARDUS 80)	
70	380(TWARDUS 80)	
80	385(TWARDUS 80)	
85	390(TWARDUS 80)	

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (%)		
	0	..	..
0	0.58(EETD 84)		
15	0(EETD 84)		

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (%)		
	0	..	..
0	0.9(EETD 84)		
15	0.1(EETD 84)		

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (%)		
	0	..	..
0	92.3(EETD 84)		
15	N/A(EETD 84)		

12.0 WEATHERING:

$$Fv = \frac{\ln(1 + 5217\ O\ \exp(6.3 - 3975.8/TK)/TK)}{(5217/TK)}$$

where: Fv is fraction of oil weathered by volume
ln is natural log
O is evaporation exposure
exp is exponential base e
TK is environmental temperature
(Kelvin, K = deg C + 273)

(EETD 84)

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (%) 0	..	..
15	42.6(EETD 84)		

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 FIRE POINT (DEG C): <10.5(TWARDUS 80)

15.2 PARAFFINS (WT %):

WEATHERING (WT %)	PARAFFINS (WT %)
0	82.3(MACKAY 82A)
10	76.9(MACKAY 82A)
20	72.5(MACKAY 82A)

15.3 AROMATICS (WT %):

WEATHERING (WT %)	AROMATICS (WT %)
0	13.2(MACKAY 82A)
10	14.7(MACKAY 82A)
20	16.4(MACKAY 82A)

15.4 WAX (WT %):

WEATHERING (WT %)	WAX (WT %)
0	5.62(MACKAY 82A)
10	8.49(MACKAY 82A)
20	9.95(MACKAY 82A)

15.5 ASPHALTENES (WT %):

WEATHERING (WT %)	ASPHALTENES (WT %)
0	2.21(MACKAY 82A)
10	4.58(MACKAY 82A)
20	6.73(MACKAY 82A)

15.6 IN-SITU COMBUSTION OF FRESH OIL: EASILY IGNITED, 5.0 WT % RESIDUE(TWARDUS 80)

1.0 TYPE: SOUTH LOUISIANA CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 37.0(API 81), 34.5(PANCIROV 74)

4.0 DENSITY (g/ml): @ 15.6 DEG C, 0.839(API 81)

5.0 VISCOSITY:

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C):

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)
5	76(API 81)
10	105(API 81)
15	132(API 81)
20	156(API 81)
25	178(API 81)
30	203(API 81)
35	221(API 81)
40	239(API 81)
45	254(API 81)
50	271(API 81)
55	284(API 81
60	302(API 81)
65	321(API 81)
70	341(API 81)
75	362(API 81)
80	384(API 81)
85	411(API 81)
90	440(API 81)
95	468(API 81)
FBP	530(API 81)

NOTE: (API 81) DATA FROM SIMULATED DISTILLATION ASTM METHOD D 2887

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 SULFUR (WT %): 0.21(API 81), 0.25(PANCIROV 74)

15.2 NITROGEN (WT %): 0.031(API 81), 0.069(PANCIROV 74)

15.3 METALS (PPM): NICKEL: 1.1(API 81), 2.2(PANCIROV 74)
VANADIUM: 0.9(API 81), 1.9(PANCIROV 74)

1.0 TYPE: SWEET BLEND CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml):

DEN = 0.8406 - 0.0006 T
where: DEN is density of fresh oil at T (g/ml)
T is oil temperature (deg C)

TEMP (DEG C)	WEATHERING (WT %) 0	10	20
0	0.840 (MACKAY 82A)		
5	0.838 (MACKAY 82A)		
10	0.835 (MACKAY 82A)		
15	0.831 (MACKAY 82A)		
20	0.829 (MACKAY 82A)	0.847 (MACKAY 82A)	0.859 (MACKAY 82A)
25	0.825 (MACKAY 82A)		

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

VISC = exp(2.89 - 4886.5 T/(273(T+273)))
where: VISC is dynamic viscosity of fresh oil at T (mPa.s)
exp is exponential base e
T is oil temperature (deg C)

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	21.0(MACKAY 82A) 20.1(TWARDUS 80)		
5	11.5(MACKAY 82A)		
10	7.99(MACKAY 82A) 14.2(TWARDUS 80)		
15	5.31(MACKAY 82A)		
20	4.77(MACKAY 82A) 8.1(TWARDUS 80)		
25	4.13(MACKAY 82A)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	25(MACKAY 82A)		
5	13.7(MACKAY 82A)		
10	9.6(MACKAY 82A)		
15	6.39(MACKAY 82A)		
20	5.75(MACKAY 82A)		
25	5.01(MACKAY 82A)		

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm): @ ROOM TEMP: 24 (TWARDUS 80)

6.2 OIL-SEAWATER (mN/m or dynes/cm): @ ? TEMP: 19.5; 16.9 @ 10 WT % WEATHERING; 20.2 @ 20 WT % WEATHERING(MACKAY 82A)

6.3 OIL-WATER (mN/m or dynes/cm): 27.3 @ ROOM TEMP (TWARDUS 80)

7.0 POUR POINT (DEG C):

WEATHERING (WT %)	POUR POINT (DEG C)
0	-33(MACKAY 82A) -35(TWARDUS 80)
10	-27(MACKAY 82A)
20	6(MACKAY 82A)

8.0 FLASH POINT (DEG C): <9(O.C.)(TWARDUS 80)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)
0	50(TWARDUS 80)
10	95(TWARDUS 80)
20	130(TWARDUS 80)
30	185(TWARDUS 80)
40	230(TWARDUS 80)
50	280(TWARDUS 80)
60	335(TWARDUS 80)
70	370(TWARDUS 80)
80	380(TWARDUS 80)
90	385(TWARDUS 80)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 IN-SITU COMBUSTION OF FRESH OIL: EASILY IGNITED, 6.1 WT % RESIDUE(TWARDUS 80)

15.2 FIRE POINT (DEG C): 10(O.C.)(TWARDUS 80)

15.3 PARAFFINS (WT %):

WEATHERING (WT %)	PARAFFINS (WT %)
0	70.6(MACKAY 82A)
10	82.5(MACKAY 82A)
20	80.8(MACKAY 82A)

15.4 AROMATICS (WT %):

WEATHERING (WT %)	AROMATICS (WT %)
0	21.0(MACKAY 82A)
10	11.9(MACKAY 82A)
20	12.8(MACKAY 82A)

15.5 WAX (WT %):

WEATHERING (WT %)	WAX (WT %)
0	2.18(MACKAY 82A)
10	3.02(MACKAY 82A)
20	3.41(MACKAY 82A)

15.6 ASPHALTENES (WT %):

WEATHERING (WT %)	ASPHALTENES (WT %)
0	3.78(MACKAY 82A)
10	3.20(MACKAY 82A)
20	3.62(MACKAY 82A)

1.0 TYPE: TARSIUT A-25 CRUDE OIL, BEAUFORT SEA.
TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 30.8(DOME 84)

4.0 DENSITY (g/ml): @ 21 DEG C, 0.8711(DOME 84)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (%) 0	..	..
20	5.432(DOME 84)		
30	4.117(DOME 84)		
40	3.155(DOME 84)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -31.9(DOME 84)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

1.0 TYPE: TARSIUT CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 23.3 TO 30.2(GULF 83); 28.0(DOME 84)

4.0 DENSITY (g/ml):

For Fv < 16.4 % & T between 0 and 15 deg C:
DEN = 0.888923 + 0.00066 Fv - 0.000324 T
where: DEN is density of oil at T and Fv (g/mL)
Fv is volume percent of oil weathered
T is oil temperature (deg C)

TEMP (DEG C)	WEATHERING (VOL %) 0	12.4	16.4
0	0.884(EETD 84)	0.8998(EETD 85)	0.9021(EETD 85)
15	0.875(EETD 84) 0.895(GULF 83)	0.8900(EETD 85)	0.8922(EETD 85)
15.6	0.8868(DOME 84)		

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (VOL %) 0	12.4	16.4
0	12.3(EETD 84)	27.0(EETD 85)	28.8(EETD 85)
15	7.4(EETD 84)	13.4(EETD 85)	13.9(EETD 85)
20	7.148(DOME 84)		
30	5.386(DOME 84)		
40	4.141(DOME 84)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	13.9(EETD 84)		
15	8.5(EETD 84)		

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	12.4	16.4
0	28.0(EETD 84)	30.7(EETD 85)	30.8(EETD 85)
15	26.5(EETD 84)	29.1(EETD 85)	27.7(EETD 85)

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	12.4	16.4
0	16.6(EETD 85)	18.0(EETD 85)	16.3(EETD 85)
15	14.1(EETD 85)	13.9(EETD 85)	14.3(EETD 85)

6.3 OIL-WATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	12.4	16.4
0	20.0(EETD 84)	19.1(EETD 85)	18.5(EETD 85)
15	18.4(EETD 85)	17.9(EETD 85)	17.8(EETD 85)

7.0 POUR POINT (DEG C): <-61(GULF 83); <-60(DOME 84)

8.0 FLASH POINT (DEG C): 65(C.C.)(EETD 84)

9.0 VAPOUR PRESSURE (kPa): 0.8(EETD 84)

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)	
0	82 TO 138	214
5		227
10	168 TO 198	237
15		248
20		261
25		274
30	227 TO 253	287
35		298
40		305
50	274 TO 306	(MODIFIED ASTM D 86)
70	334 TO 371	(EETD 85)
90	431 TO 457	
FINAL	567 TO 610	
	(GULF 83)	

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

		WEATHERING (VOL %)	
TEMP (DEG C)	0	12.4	16.4
0	0(EETD 84)		
15	0(EETD 84)	0(EETD 85)	0(EETD 85)

11.2 EMULSION STABILITY:

		WEATHERING (VOL %)	
TEMP (DEG C)	0	12.4	16.4
0	0(EETD 84)		
15	0(EETD 84)	0(EETD 85)	0(EETD 85)

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

		WEATHERING (VOL %)	
TEMP (DEG C)	0	12.4	16.4
0	N/A(EETD 84)		
15	N/A(EETD 84)	N/A(EETD 85)	N/A(EETD 85)

12.0 WEATHERING:

$$Fv = \frac{\ln(1 + 2418\ O\ \exp(6.3 - 5016/TK)/TK)}{(2418/TK)}$$

where: Fv is fraction of oil weathered by volume
ln is natural log
O is evaporation exposure
exp is exponential base e
TK is environmental temperature
(Kelvin, K = deg C + 273)

(EETD 85)

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	12.4	16.4
0	26.6(EETD 85)	20.5(EETD 85)	24.1(EETD 85)
15	33.2(EETD 85)	26.2(EETD 85)	24.8(EETD 85)

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILITY (% DISPERSED):

OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (DEG C)	WEATHERING (VOL %) 0	12.4	16.4
0	76(EETD 85)	57(EETD 85)	62(EETD 85)
15	81(EETD 85)	53(EETD 85)	72(EETD 85)

14.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (DEG C)	WEATHERING (VOL %) 0	12.4	16.4
0	38(EETD 85)	16(EETD 85)	17(EETD 85)
15	30(EETD 85)	22(EETD 85)	39(EETD 85)

15.0 OTHERS:

15.1 CARBON RESIDUE (WT %): 36(GULF 83)

15.2 SULPHUR (WT %): 0.09 TO 0.15(GULF 83)

15.3 METALS (PPM): NICKEL: 0.5(GULF 83)
VANADIUM: 0.34(GULF 83)
COPPER: 1.57(GULF 83)
IRON: 9.57(GULF 83)

1.0 TYPE: TERRA NOVA K-08 DST#1 CRUDE OIL.

2.0 COLOUR:

3.0 API GRAVITY:

WEATHERING (WT %) 0	5.0	14.9
31.0 (PETRO-CAN 85)	29.5 (PETRO-CAN 85)	29.0 (PETRO-CAN 85)

4.0 DENSITY (g/ml):

TEMP (DEG C)	WEATHERING (WT %) 0	5.0	14.9
15	0.8704 (PETRO-CAN 85)	0.8786 (PETRO-CAN 85)	0.8809 (PETRO-CAN 85)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (WT %) 0	5.0	14.9
25	SOLID (PETRO-CAN 85)	SOLID (PETRO-CAN 85)	SOLID (PETRO-CAN 85)
50	8.7 (PETRO-CAN 85)	11.7 (PETRO-CAN 85)	17.8 (PETRO-CAN 85)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C):

WEATHERING (WT %)	POUR POINT (DEG C)
0	27(PETRO-CAN 85)
5.0	30(PETRO-CAN 85)
14.9	33(PETRO-CAN 85)

8.0 FLASH POINT (DEG C):

WEATHERING (WT %)	FLASH POINT (DEG C)
0	<21(PETRO-CAN 85)
5.0	32(PETRO-CAN 85)
14.9	61(PETRO-CAN 85)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA (DEG C):

VOLUME PERCENT	WEATHERING (WT %) 0	5.0	14.9
IBP	25	85	111
5	98	136	183
10	136	173	217
20	207	240	276
30	270	300	329
40	330	356	381
50	390	412	431
60	448	465	481
70	519	531	546
% off at 524 deg C	70.5	69.1	66.9

(ASTM D2887-MODIFIED)(PETRO-CAN 85)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (WT %) 0	5.0	14.9
1	0.15(ROSS 85)	0(ROSS 85)	0(ROSS 85)
15	1.0(ROSS 85)	1.0(ROSS 85)	0(ROSS 85)

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (WT %) 0	5.0	14.9
1	1.0(ROSS 85)	0(ROSS 85)	0(ROSS 85)
15	1.0(ROSS 85)	1.0(ROSS 85)	0.93(ROSS 85)

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (WT %) 0	5.0	14.9
1	49.3(ROSS 85)	0(ROSS 85)	0(ROSS 85)
15	88.9(ROSS 85)	84.6(ROSS 85)	57.6(ROSS 85)

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (WT %) 0	5.0	14.9
0	DNS(ROSS 85)	DNS(ROSS 85)	DNS(ROSS 85)
15	DNS(ROSS 85)	DNS(ROSS 85)	DNS(ROSS 85)

NOTE: DNS=DID NOT SPREAD

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 AQUEOUS SOLUBILITY (g/m^3):
in 35 ppt seawater at 22 deg C

WEATHERING (WT %)	SOLUBILITY (g/m^3)
0	19.0(ROSS 85)
5.0	13.5(ROSS 85)
14.9	1.3(ROSS 85)

15.2 SULFUR (WT %):

WEATHERING (WT %)	SULFUR (WT %)
0	0.70(PETRO-CAN 85)
5.0	0.74(PETRO-CAN 85)
14.9	0.80(PETRO-CAN 85)

1.0 TYPE: TERRA NOVA K-08 DST#2 CRUDE OIL.

2.0 COLOUR:

3.0 API GRAVITY:

WEATHERING (WT %) 0	5.0
32.9 (PETRO-CAN 85)	30.3 (PETRO-CAN 85)

4.0 DENSITY (g/ml):

TEMP (DEG C)	WEATHERING (WT %) 0	5.0
15	0.8604 (PETRO-CAN 85)	0.8742 (PETRO-CAN 85)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (WT %) 0	5.0
25	16.7 (PETRO-CAN 85)	26.5 (PETRO-CAN 85)
50	5.7 (PETRO-CAN 85)	7.8 (PETRO-CAN 85)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C):

WEATHERING (WT %)	POUR POINT (DEG C)
0	12(PETRO-CAN 85)
5.0	15(PETRO-CAN 85)

8.0 FLASH POINT (DEG C):

WEATHERING (WT %)	FLASH POINT (DEG C)
0	<21(PETRO-CAN 85)
5.0	<21(PETRO-CAN 85)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA (DEG C):

VOLUME PERCENT	WEATHERING (WT %) 0	5.0
IBP	2	44
5	87	107
10	117	140
20	173	198
30	233	253
40	288	310
50	346	366
60	408	425
70	472	486
% off at 524 deg C	76.0	75.1

(ASTM D2887-MODIFIED)(PETRO-CAN 85)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (WT %) 0	5.0	19.5
1	1.0(ROSS 85)	1.0(ROSS 85)	1.0(ROSS 85)
15	1.0(ROSS 85)	1.0(ROSS 85)	1.0(ROSS 85)

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (WT %) 0	5.0	19.5
1	1.0(ROSS 85)	1.0(ROSS 85)	1.0(ROSS 85)
15	1.0(ROSS 85)	1.0(ROSS 85)	1.0(ROSS 85)

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (WT %) 0	5.0	19.5
1	90.1(ROSS 85)	87.6(ROSS 85)	51.1(ROSS 85)
15	90.0(ROSS 85)	89.4(ROSS 85)	88.8(ROSS 85)

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (WT %) 0	5.0	19.5
1	DNS(ROSS 85)	DNS(ROSS 85)	DNS(ROSS 85)
15	9.0(ROSS 85)	5.2(ROSS 85)	DNS(ROSS 85)

NOTE: DNS=DID NOT SPREAD

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 AQUEOUS SOLUBILITY (g/m^3):

in 35 ppt seawater at 22 deg C

WEATHERING (WT %)	SOLUBILITY (g/m^3)
0	27.0(ROSS 85)
5.0	19.1(ROSS 85)
19.5	0.9(ROSS 85)

15.2 SULFUR (WT %):

WEATHERING (WT %)	SULFUR (WT %)
0	0.69(PETRO-CAN 85)
5.0	0.71(PETRO-CAN 85)

1.0 TYPE: TERRA NOVA K-08 DST#3 CRUDE OIL.

2.0 COLOUR:

3.0 API GRAVITY:

	WEATHERING (WT %)	
0	5.0	14.8
32.6 (PETRO-CAN 85)	30.5 (PETRO-CAN 85)	27.6 (PETRO-CAN 85)

4.0 DENSITY (g/ml):

TEMP		WEATHERING (WT %)	
(DEG C)	0	5.0	14.8
15	0.8620 (PETRO-CAN 85)	0.8729 (PETRO-CAN 85)	0.8891 (PETRO-CAN 85)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP		WEATHERING (VOL %)	
(DEG C)	0	5.0	14.8
25	18.7 (PETRO-CAN 85)	22.8 (PETRO-CAN 85)	201 (PETRO-CAN 85)
50	5.9 (PETRO-CAN 85)	8.2 (PETRO-CAN 85)	14.1 (PETRO-CAN 85)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C):

WEATHERING (WT %)	POUR POINT (DEG C)
0	12(PETRO-CAN 85)
5.0	18(PETRO-CAN 85)
14.8	24(PETRO-CAN 85)

8.0 FLASH POINT (DEG C):

WEATHERING (WT %)	FLASH POINT (DEG C)
0	<21(PETRO-CAN 85)
5.0	<21(PETRO-CAN 85)
14.8	52(PETRO-CAN 85)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA (DEG C):

VOLUME PERCENT	WEATHERING (WT %) 0	5.0	14.8
IBP	1	69	115
5	86	116	168
10	117	147	202
20	176	208	259
30	238	266	312
40	297	321	366
50	356	379	421
60	420	438	477
70	487	502	547
% off at 524 deg C	74.0	72.9	67.0

(ASTM D2887-MODIFIED)(PETRO-CAN 85)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (WT %) 0	5.0	14.8
1	1.0(ROSS 85)	1.0(ROSS 85)	0.1(ROSS 85)
15	1.0(ROSS 85)	1.0(ROSS 85)	1.0(ROSS 85)

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (WT %) 0	5.0	14.8
1	1.0(ROSS 85)	1.0(ROSS 85)	1.0(ROSS 85)
15	1.0(ROSS 85)	1.0(ROSS 85)	1.0(ROSS 85)

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (WT %) 0	5.0	14.8
1	88.3(ROSS 85)	87.1(ROSS 85)	76.1(ROSS 85)
15	90.1(ROSS 85)	90.1(ROSS 85)	90.0(ROSS 85)

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

		WEATHERING (WT %)	
TEMP (DEG C)	0	5.0	14.8
1	DNS(ROSS 85)	DNS(ROSS 85)	DNS(ROSS 85)
15	9.8(ROSS 85)	8.0(ROSS 85)	DNS(ROSS 85)

NOTE: DNS=DID NOT SPREAD

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 AQUEOUS SOLUBILITY (g/m^3):
in 35 ppt seawater at 22 deg C

WEATHERING (WT %)	SOLUBILITY (g/m^3)
0	23.1(ROSS 85)
5.0	20.7(ROSS 85)
14.8	3.4(ROSS 85)

15.2 SULFUR (WT %):

WEATHERING (WT %)	SULFUR (WT %)
0	0.68(PETRO-CAN 85)
5.0	0.71(PETRO-CAN 85)
14.8	0.76(PETRO-CAN 85)

1.0 TYPE: TERRA NOVA K-08 DST#4 CRUDE OIL.

2.0 COLOUR:

3.0 API GRAVITY:

WEATHERING (WT %) 0	5.1	14.2
32.5 (PETRO-CAN 85)	30.4 (PETRO-CAN 85)	27.5 (PETRO-CAN 85)

4.0 DENSITY (g/ml):

TEMP (DEG C)	WEATHERING (WT %) 0	5.1	14.2
15	0.8621 (PETRO-CAN 85)	0.8735 (PETRO-CAN 85)	0.8895 (PETRO-CAN 85)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (WT %) 0	5.1	14.2
25	18.2 (PETRO-CAN 85)	27.3 (PETRO-CAN 85)	105 (PETRO-CAN 85)
50	5.9 (PETRO-CAN 85)	8.1 (PETRO-CAN 85)	13.8 (PETRO-CAN 85)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C):

WEATHERING (WT %)	POUR POINT (DEG C)
0	12(PETRO-CAN 85)
5.1	15(PETRO-CAN 85)
14.2	21(PETRO-CAN 85)

8.0 FLASH POINT (DEG C):

WEATHERING (WT %)	FLASH POINT (DEG C)
0	<21(PETRO-CAN 85)
5.1	<21(PETRO-CAN 85)
14.2	60(PETRO-CAN 85)

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA (DEG C):

VOLUME PERCENT	WEATHERING (WT %) 0	5.1	14.2
IBP	3	76	130
5	90	120	175
10	119	151	210
20	177	210	267
30	234	264	320
40	290	316	377
50	345	370	434
60	405	427	494
70	467	484	
% off at 524 deg C	77.0	75.6	64.2

(ASTM D2887-MODIFIED)(PETRO-CAN 85)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (WT %) 0	5.1	14.2
1	1.0(ROSS 85)	1.0(ROSS 85)	1.0(ROSS 85)
15	1.0(ROSS 85)	1.0(ROSS 85)	1.0(ROSS 85)

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (WT %) 0	5.1	14.2
1	1.0(ROSS 85)	1.0(ROSS 85)	1.0(ROSS 85)
15	1.0(ROSS 85)	1.0(ROSS 85)	1.0(ROSS 85)

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (WT %) 0	5.1	14.2
1	89.8(ROSS 85)	86.7(ROSS 85)	67.5(ROSS 85)
15	87.4(ROSS 85)	93.9(ROSS 85)	89.3(ROSS 85)

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (WT %) 0	5.1	14.2
0	DNS(ROSS 85)	DNS(ROSS 85)	DNS(ROSS 85)
15	8.6(ROSS 85)	6.6(ROSS 85)	DNS(ROSS 85)

NOTE: DNS=DID NOT SPREAD

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 AQUEOUS SOLUBILITY (g/m^3):

in 35 ppt seawater at 22 deg C

WEATHERING (WT %)	SOLUBILITY (g/m^3)
0	18.7(ROSS 85)
5.1	14.6(ROSS 85)
14.2	2.2(ROSS 85)

15.2 SULFUR (WT %):

WEATHERING (WT %)	SULFUR (WT %)
0	0.67(PETRO-CAN 85)
5.1	0.69(PETRO-CAN 85)
14.2	0.74(PETRO-CAN 85)

1.0 TYPE: TRANSMOUNTAIN BLEND CRUDE OIL. TYPICAL DATA

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml):

For Fv < 28.5 % & T between 0 and 15 deg. C:
DEN = 0.866996 + 0.002108 Fv - 0.000758 T
where: DEN is density of oil at T and Fv (g/mL)
Fv is volume percent of oil weathered
T is oil temperature (deg C)

TEMP (DEG C)	WEATHERING (VOL %) 0	18.8	28.5
0	0.865(EETD 84)	0.9107(EETD 85)	0.9250(EETD 85)
15	0.855(EETD 84)	0.8989(EETD 85)	0.9127(EETD 85)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (VOL %) 0	18.8	28.5
0	650(EETD 85)	>10000(EETD 85)	>>10000(EETD 85)
15	10.5(EETD 85)	142(EETD 85)	577(EETD 85)

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP (DEG C)	WEATHERING (VOL %) 0	18.8	28.5
0	750(EETD 85)		
15	12.3(EETD 84)	158(EETD 85)	632(EETD 85)

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	18.8	28.5
0	28.8(EETD 85)	N/M(EETD 85)	N/M(EETD 85)
15	25.0(EETD 84)	29.1(EETD 85)	N/M(EETD 85)

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	18.8	28.5
0	19.9(EETD 85)	N/M(EETD 85)	N/M(EETD 85)
15	19.3(EETD 84)	25.1(EETD 85)	N/M(EETD 85)

6.3 OIL-WATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	18.8	28.5
0	20.5(EETD 85)	N/M(EETD 85)	N/M(EETD 85)
15	19.3(EETD 84)	26.5(EETD 85)	N/M(EETD 85)

7.0 POUR POINT (DEG C):

WEATHERING (VOL %)	POUR POINT (DEG C)
0	2(EETD 85)
18.8	8(EETD 85)
28.5	18(EETD 85)

8.0 FLASH POINT (DEG C): -2.0(C.C.)(EETD 85)

9.0 VAPOUR PRESSURE (kPa): 45.7(EETD 84)

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)
IBP	113
5	144
10	174
15	203
20	234
25	265
30	295(MODIFIED ASTM D 86)(EETD 85)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (VOL %) 0	18.8	28.5
0	1.0(EETD 85)	1.0(EETD 85)	0(EETD 85)
15	0.2(EETD 84)	1.0(EETD 85)	1.0(EETD 85)

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (VOL %) 0	18.8	28.5
0	1.0(EETD 85)	1.0(EETD 85)	0(EETD 85)
15	0.1(EETD 84)	1.0(EETD 85)	1.0(EETD 85)

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (VOL %) 0	18.8	28.5
0	90.1(EETD 85)	75.4(EETD 85)	N/A(EETD 85)
15	N/A(EETD 84)	89.0(EETD 85)	87.0(EETD 85)

12.0 WEATHERING:

$$Fv = \frac{\ln(1 + 6488\ O\ \exp(6.3 - 3924.3/TK)/TK)}{(6488/TK)}$$

where: Fv is fraction of oil weathered by volume
ln is natural log
O is evaporation exposure
exp is exponential base e
TK is environmental temperature
(Kelvin, K = deg C + 273)

(EETD 84)

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0	18.8	28.5
0	22.5(EETD 85)	<0(EETD 85)	<0(EETD 85)
15	24.9(EETD 85)	15.0(EETD 85)	<0(EETD 85)

14.0 DISPERSIBILITY:

14.1 CHEMICAL DISPERSIBILTY (% DISPERSED):

OIL TO DISPERSANT RATIO : 20 TO 1.

TEMP (DEG C)	WEATHERING (VOL %) 0	18.8	28.5
0	40(EETD 85)	0(EETD 85)	0(EETD 85)
15	84(EETD 85)	79(EETD 85)	83(EETD 85)

14.2 NATURAL DISPERSIBILITY (% DISPERSED):

TEMP (DEG C)	WEATHERING (VOL %) 0	18.8	28.5
0	0(EETD 85)	0(EETD 85)	0(EETD 85)
15	1(EETD 84)	0(EETD 85)	0(EETD 85)

15.0 OTHERS:

1.0 TYPE: UKALERK 2C-50 CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 45.7(DOME 84)

4.0 DENSITY (g/ml): @ 21 DEG C, 0.7978(DOME 84)

5.0 VISCOSITY:

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): 1.7(DOME 84)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

1.0 TYPE: UVILUK P-66 CRUDE OIL FROM DOME, TEXACO ET AL., 1983.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml):

For fresh oil and T between 0 and 25 deg C:
DEN = 0.91542 - 0.000727 T
where: DEN is density of oil at T
T is oil temperature (deg C)

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0	0.9155(EETD 85)		
15	0.9040(EETD 85)		
20	0.9012(EETD 85)		
25	0.8972(EETD 85)		

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (VOL %) 0	..	..
0			
15			

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

TEMP	WEATHERING (VOL %)		
(DEG C)	0	..	..
0			
15			

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm):

TEMP	WEATHERING (VOL %)
(DEG C)	0
0	
15	28.6(EETD 85)

6.2 OIL-SEAWATER (mN/m or dynes/cm):

TEMP	WEATHERING (VOL %)
(DEG C)	0
0	
15	8.8(EETD 85)

6.3 OIL-WATER (mN/m or dynes/cm):

TEMP	WEATHERING (VOL %)
(DEG C)	0
0	
15	21.4(EETD 85)

7.0 POUR POINT (DEG C):

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA (DEG C):

VOLUME PERCENT	MODIFIED ASTM DISTILLATION	ASTM DISTILLATION
IBP	185	69
5	209	108
10	233	114
15	257	148
20	281	162
25	305	171
	(MODIFIED ASTM D 86) (EETD 85)	(ASTM D 86) (EETD 85)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

11.1 EMULSION FORMATION TENDENCY:

TEMP (DEG C)	WEATHERING (VOL %) 0
0	
15	0(EETD 85)

11.2 EMULSION STABILITY:

TEMP (DEG C)	WEATHERING (VOL %) 0
0	
15	0(EETD 85)

11.3 WATER CONTENT OF STABLE EMULSION (VOL %):

TEMP (DEG C)	WEATHERING (VOL %) 0
0	
15	N/A(EETD 85)

12.0 WEATHERING:

$$Fv = \frac{\ln(1 + 4906\ O\ \exp(6.3 - 4722/TK)/TK)}{(4906/TK)}$$

where: Fv is fraction of oil weathered by volume
ln is natural log
O is evaporation exposure
exp is exponential base e
TK is environmental temperature
(Kelvin, K = deg C + 273)
(EETD 85)

13.0 SPREADING COEFFICIENT ON SEAWATER (mN/m or dynes/cm):

TEMP (DEG C)	WEATHERING (VOL %) 0
0	
15	33.8(EETD 85)

14.0 DISPERSIBILITY:

15.0 OTHERS:

1.0 TYPE: WAINWRIGHT-KINSELLA CRUDE OIL, ALBERTA.
TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY: 23.1(AALUND 83A)

4.0 DENSITY (g/ml): @ 21 DEG C, 0.9145(AALUND 83A)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt): @ 40 DEG C,
32.50(AALUND 83A)

6.0 INTERFACIAL TENSIONS:

7.0 POUR POINT (DEG C): -39.0(AALUND 83A)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa): 30.3(AALUND 83A)

10.0 ASTM DISTILLATION DATA:

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 SULFUR (PPM): 15,800(AALUND 83A)

15.2 CON. CARBON (WT %): 6.70(AALUND 83A)

15.3 METALS (PPM): NICKEL: 40.30(AALUND 83A)
VANADIUM: 79.90(AALUND 83A)

1.0 TYPE: WEYBURN-MIDALE CRUDE OIL. TYPICAL DATA.

2.0 COLOUR:

3.0 API GRAVITY:

4.0 DENSITY (g/ml): @ ROOM TEMP: 0.89(TWARDUS 80)

5.0 VISCOSITY:

5.1 DYNAMIC VISCOSITY (mPa.s or cp):

TEMP (DEG C)	WEATHERING (%) 0	..	..
0	88(TWARDUS 80)		
10	29(TWARDUS 80)		
20	18(TWARDUS 80)		

5.2 KINEMATIC VISCOSITY (mm^2/sec or cSt):

6.0 INTERFACIAL TENSIONS:

6.1 AIR-OIL (mN/m or dynes/cm): @ ROOM TEMP: 24.1 (TWARDUS 80)

6.2 OIL-WATER (mN/m or dynes/cm): @ ROOM TEMP: 29.7 (TWARDUS 80)

7.0 POUR POINT (DEG C): -28(TWARDUS 80)

8.0 FLASH POINT (DEG C):

9.0 VAPOUR PRESSURE (kPa):

10.0 ASTM DISTILLATION DATA:

VOLUME PERCENT	TEMP (DEG C)
0	45(TWARDUS 80)
10	90(TWARDUS 80)
20	130(TWARDUS 80)
30	190(TWARDUS 80)
40	230(TWARDUS 80)
50	265(TWARDUS 80)
60	275(TWARDUS 80)
70	335(TWARDUS 80)
80	385(TWARDUS 80)

11.0 EMULSION FORMATION TENDENCY & STABILITY:

12.0 WEATHERING:

13.0 SPREADING COEFFICIENT ON SEAWATER:

14.0 DISPERSIBILITY:

15.0 OTHERS:

15.1 IN-SITU COMBUSTION OF FRESH OIL: EASILY IGNITED, 7.4 VOL % RESIDUE (TWARDUS 80)

15.2 FIRE POINT (DEG C): <14(TWARDUS 80)

4.0 REFERENCES

Aalund 1983
Aalund, L. R., "Guide to Export Crudes for the '80s - Part 13, Assay Series Concludes with Index, U.S. Streams", Oil & Gas Journal, Dec. 19, Pg 71-74 (1983).

Aalund 1983a
Aalund, L. R., "Guide to Export Crudes for the '80s - Part 12, Important North American Crudes", Oil & Gas Journal, Dec. 12, Pg 120-125 (1983).

API 1981
Anonymous, "API-EPA Sample Analysis of Standard Reference Oils", American Petroleum Institute and Environmental Protection Agency, reference number P. O. #71271 (1981).

ASTM 1979
American Society for Testing and Materials, "Compilation of ASTM Standard Definitions", 4th edition, ASTM Committee on Terminology, Publication No. PCN 03-001079-42 (1979).

ASTM D 56
American Society for Testing and Materials, "ASTM D 56, Standard Test Method for Flash Point by Tag Closed Tester", Annual Books of ASTM Standards, Part 23 (1980).

ASTM D 86
American Society for Testing and Materials, "ASTM D 86, Standard Methods for Distillation of Petroleum Products", ASTM Annual Books of Standards, Part 23 (1980).

ASTM D 92
American Society for Testing and Materials, "ASTM D 92, Standard Test Method for Flash and Fire Points by Cleveland Open-cup", Annual Books of ASTM Standards, Part 23 (1980).

ASTM D 93
American Society for Testing and Materials, "ASTM D 93, Standard Test Methods for Flash Point by Pensky-Martens Closed Tester", Annual Books of ASTM Standards, Part 23 (1980).

ASTM D 97
American Society for Testing and Materials, "ASTM D 97, Standard Method of Testing for Pour Point of Petroleum Oils", Annual Books of ASTM Standards, Part 23 (1980).

ASTM D 189
American Society for Testing and Materials, "ASTM D 189, Standard Test Method for Conradson Carbon Residue of Petroleum Products", Annual Books of ASTM Standards, Part 23 (1980).

ASTM D 285
American Society for Testing and Materials, "ASTM D 285, Standard Method for Distillation of Crude Petroleum", Annual Books of ASTM Standards, Part 23 (1980).

ASTM D 323
American Society for Testing and Materials, "ASTM D 323, Standard Test Method for Vapour Pressure of Petroleum Products (Reid Method), Annual Books of ASTM Standards, Part 23 (1980).

ASTM D 396
American Society for Testing and Materials, "ASTM D 396, Standard Specification for Fuel Oils", Annual Books of ASTM Standards, Part 23 (1980).

ASTM D 439
American Society for Testing and Materials, "ASTM D 439, Standard Specification for Automotive Gasoline", Annual Books of ASTM Standards, Part 23 (1980).

ASTM D 445
American Society for Testing and Materials, "ASTM D 445, Standard Test Methods for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)", Annual Books of ASTM Standards, Part 23 (1980).

ASTM D 524
American Society for Testing and Materials, "ASTM D 524, Standard Test Method for Ramsbottom Carbon Residue of Petroleum Products", Annual Books of ASTM Standards, Part 23 (1980).

ASTM D 971
American Society for Testing and Materials, "ASTM D 971, Standard Test Method for Interfacial Tension of Oil against Water by the Ring Method", Annual Books of ASTM Standards, Part 23 (1980).

ASTM D 1310
American Society for Testing and Materials, "ASTM D 1310, Standard Test Method for Flash Point of Liquids by Tag Open-cup Apparatus", Annual Books of ASTM Standards, Part 23 (1980).

ASTM D 1480
American Society for Testing and Materials, "ASTM D 1480, Standard Test Method for Density and Relative Density (Specific Gravity) of Viscous Materials by Binghan Pycnometer", Annual Books of ASTM Standards, Part 23 (1980).

ASTM D 1552
American Society for Testing and Materials, "ASTM D 1552, Standard Test Method for Sulphur in Petroleum Products (High-temperature Method)", Annual Books of ASTM Standards, Part 23 (1980).

ASTM D 2385
American Society for Testing and Materials, "ASTM D 2385, Standard Test Method for Hydrogen Sulphide and Mercaptan Sulphur in Natural Gas (Cadmium Sulphate - Iodometric Titration Method)", Annual Books of ASTM Standards, Part 24 (1980).

ASTM D 2420
American Society for Testing and Materials, "ASTM D 2420, Standard Test Method for Hydrogen Sulphide in Liquefied Petroleum (LP) Gases (Lead Acetate Method)", Annual Books of ASTM Standards, Part 24 (1980).

ASTM D 2551
American Society for Testing and Materials, "ASTM D 2551, Standard Test Methods for Vapour Pressure of Petroleum Products (Micromethod)", Annual Books of ASTM Standards, Part 24 (1980).

ASTM D 2788
American Society for Testing and Materials, "ASTM D 2788, Standard Test Method for Trace Metals in Gas Turbine Fuels (Atomic Absorption Method)", Annual Books of ASTM Standards, Part 24 (1980).

ASTM D 2879
American Society for Testing and Materials, "ASTM D 2879, Standard Test Method for Vapour Pressure-Temperature Relationship and Initial Decomposition Temperature of Liquids by Isoteniscope", Annual Books of ASTM Standards, Part 24 (1980).

ASTM D 3828
American Society for Testing and Materials, "ASTM D 3828, Standard Test Methods for Flash Point by Setaflash Closed Tester", Annual Books of ASTM Standards, Part 25 (1980).

ASTM E 133
American Society for Testing and Materials, "ASTM E 133, Standard Specification for Distillation Equipment", Annual Books of ASTM Standards, Part 24 (1980).

Bland 1967
Bland, W.F. & Davidson, R. L., "Petroleum Processing Handbook", McGraw-Hill, New York (1967).

Bobra 1983
Bobra, A. M., Shiu, W. Y., Mackay, D., "Toxicity of Hydrocarbons and Crude Oils", Proceedings of the Sixth Artic Marine Oilspill Program Technical Seminar (1983).

Charles 1984
Charles, M.E., "Transportation and Storage Of Benthorn Crude Oil: Rheological Characterization and Thermal Modelling", submitted to Panarctic Oils Ltd., Calgary (1984).

Charles 1984
Charles, M.E., "Transportation and Storage Of Benthorn Crude Oil: Rheological Characterization and Thermal Modelling", A further study emphasizing physical modelling of heating of crude oil submitted to Panarctic Oils Ltd., Calgary (1984).

Cormack 1978
Cormack, D., Nichols, J. A., Lynch, B., "Investigation of Factors Affecting the Fate of North Sea Oils Discharged at Sea, Part 1: Ekofisk Crude Oil July 1975 - February 1978", Warren Spring Laboratory, Report No. LR 273(OP) (1978).

Curl 1977
Curl, H., Jr. & O'Donnell, K., "Chemical and Physical Properties of Refined Petroleum Products", Environmental Research Laboratories, National Oceanic and Atmospheric Administration, U.S. Department of Commerce (1977).

Dome 1984
Private Communication, Dome Petroleum to Environmental Emergency Technology Division, Technical Services Branch, Environmental Protection Service, Environment Canada (1984).

EETD 1984/1985
Experimental data from Environmental Emergencies Technology Division, Technical Services Branch, Environmental Protection Service, Environment Canada (1984/1985).

Engelhardt 1984
Engelhardt, F. R., ed., "Petroleum Effects in the Artic Environment", (in preparation) (1984).

Esso 1983
Private Communication, Esso Resources Canada Limited to Environmental Emergency Technology Division, Technical Services Branch, Environmental Protection Service, Environment Canada (1983).

Esso 1984
Esso Petroleum Canada. Product Data, Product Health and Safety Data Sheets on Voltesso 35 (1984).

Fingas 1979
Fingas, M.F., Duval, W.S. & Stevenson, G. B., "The Basics of Oil Spill Cleanup", Environmental Emergency Branch, Environmental Protection Service, Environment Canada (1979).

Gulf 1983
Gulf Canada Resources Inc., "East Tarsiut Crude Oil Analysis", Internal Report, File No. 187-80-29 (1983).

HMSO 1976
Her Majesty's Stationery Office, "Accidental Oil Pollution of the Sea", Depatment of the Environment Central Unit on Environmental Pollution, A Report by Officials on Oil Spills and Clean up Measures, Pollution Paper #8 (1976).

Hutcheson 1983
Hutcheson, M. S., Keizer, P. O. & Odense, R., "Chemistry and Toxicity of the Venture Field Condensates", Prepared for Mobil Oil Canada Ltd. (1983).

IP 1980
Institute of Petroleum, "IP 35, Flash Point (Open) and Fire Point by means of the Pensky-Martens Apparatus", IP Standards for Petroleum and its Products, Part 1, Methods for Analysis and Testing, Vol 1 (1980).

Lance 1979
Lance, R.C., Barnard, A.J., Jr & Hooyman, J.E., "Measurement of Flash Points: Apparatus, Methodology, & Applications", Journal of Hazardous Materials, Vol 3, Pg 107-119 (1979).

Lynch 1981
Lynch, B. W. J., "The Fate of Controlled Oil Spills at Sea", Warren Spring Laboratory, Report No. LR 390(OP) (1981).

Mackay 1974
Mackay, D., Charles, M.E. & Phillips, C. R., "The Physical Aspects of Crude Oil Spills on Northern Terrain, for The Environmental-Social Program", Task Force on Northern Oil Development, Report No. 73-42 (Info. Can. Cat. No. R72-9173) (1974).

Mackay 1975
Mackay, D., Charles, M. E. & Phillips, C. R., "The Physical Aspects of Crude Oil Spills On Northhern Terrain (Final Report)", Ministry of Indian and Northern Affairs, INA Pub. No. QS 8060-000-EE-AI (1975).

Mackay 1980a
Mackay, D., Hossain, K. & Shiu, W. Y., "Analysis of Beaufort Sea and Prudhoe Bay Crude Oils", Department of Chemical Engineering and Applied Chemistry, University of Toronto (1980).

Mackay 1980b
Mackay, D. & Szeto, F., "Effectiveness of Oil Spill Dispersants. Development of a Laboratory Method and Results for Selected Commercial Products", Institute for Environmental Studies, University of Toronto, Publication No. EE-16 (1980).

Mackay 1982a
Mackay, D. & Zagorski, W., "Studies of Water-In-Oil Emulsions", Prepared for Research and Development Division, Environmental Emergency Branch, Environmental Impact Control Directorate, Environmental Protection Service, Environment Canada, Publication No. EE-34 (1982).

Mackay 1982b
Mackay, D., Shiu, W. Y., Hossain, K., Stiver. W., McCurdy, D., Paterson, S. & Tebeau, P.A., "Development and Calibration of an Oil Spill Behaviour Model", Prepared for U.S. Coast Guard (1982).

Mackay 1983a
Mackay, D., Stiver, W. & Tebeau, P.A., "Testing for Crude Oils & Petroleum Products for Environmental Purposes", Proceedings for the 1983 Oil Spill Conference at San Antonio, Texas (1983).

Mackay 1983b
Mackay, D., & Stiver, W., "Evaporation Rate of Spills of Hydrocarbons and Petroleum Mixtures", for Environmental Emergencies Technology Division, Technical Services Branch, Environmental Protection Programs Directorate, Environment Canada, Publication EE-49 (1983).

Mackay 1984a
Mackay, D., & Nowak, M., "Formation and Stability of Water-in-Oil Emulsions", for Environmental Emergencies Techology Division, Technical Services Branch, Environmental Protection Programs Directorate, Environmental Protection Service, Environment Canada (in preparation) (1984).

Martin 1977
Martin, S., Kauffman, P. & Welander, P.E., "A Laboratory Study of the Dispersion of Crude Oil within Sea Ice Grown in a Wave Field", 27th Alaska Science Conference Proceedings (1977).

Naval 1977
Anonymous, "Oil Spill Control for Inland Waters and Harbors", Naval Facilities Engineering Comand, Department of the Navy, Report No. NAVFAC P-908 (1977).

Nelson 1958
Nelson, W.L., "Petroleum Refinery Engineering", McGraw-Hill, New York (1958).

OECD 1981
Anonymous, "OECD Guidelines for Testing of Chemicals", the Organization for Economic Co-operation and Development, Paris, France (1981).

Oilweek 1985
Anonymous, "Bent Horn Readies for First Production", Oilweek Magazine, pp.20-21, June 17, 1985.

OHMTADS 1981
Anonymous, "Oil and Hazardous Materials Technical Assistance Data System", Office of Water Program Operations, Oil and Special Materials Control Division, U.S. EPA (1981).

Panarctic 1984
Panarctic Oils Ltd., "Bent Horn Production Project Application For Development Plan Approval" (1984).

Pancirov 1974
Pancirov, R.J., "Compositional Data on API Reference Oils Used in Biological Studies: a #2 Fuel Oil, a Bunker C, Kuwait Crude Oil, and South Louisiana Crude Oil", Esso Research and Engineering Company, Report No. AID.1BA.74 (1974).

Petro-Canada 1972
Private Communication, Petro-Canada Products Inc. to S.L. Ross Environment Research Ltd., (1971).

Petro-Canada 1973
Private Communication, Petro-Canada Products Inc. to S.L. Ross Environment Research Ltd., (1973).

Petro-Canada 1975
Private Communication, Petro-Canada Products Inc. to S.L. Ross Environment Research Ltd., (1975).

Petro-Canada 1980
Private Communication, Petro-Canada Products Inc. to S.L. Ross Environment Research Ltd., (1980).

Petro-Canada 1981
Private Communication, Petro-Canada Products Inc. to S.L. Ross Environment Research Ltd., (1981).

Petro-Canada 1982
Private Communication, Petro-Canada Products Inc. to S.L. Ross Environment Research Ltd., (1982).

Perez 1979
Perez, R.H., "Mexico's Export Oil: Its Source and Qualities", Oil and Gas Journal, Vol.77 (8), Pg 89-91 (1979).

Perry 1973
Perry, R.H. & Chilton, C. H., ed., "Chemical Engineers' Handbook", 5th ed., McGraw-Hill, New York (1973).

Ross 1982a
Ross, S.L., Environmental Research Ltd., "The Behaviour and Fate of Gas and Condensate Spills", Prepared for Mobil Oil Canada Limited's Venture Gas Field Development (1982).

Ross 1984
Ross, S.L., Environmental Research Ltd., "Hibernia Oil Spills and their Control", Prepared for Mobil Oil Canada Ltd. (1984).

Ross 1985
Ross, S.L., Environmental Research Ltd., "Spill-Related Properties of Terra Nova Crude Oils", Prepared for Petro-Canada Resources, (1985).

Skoog 1976
Skoog, D.A. & West, D.M., "Fundamentals of Analytical Chemistry", 3rd ed, Holt, Rinehart and Winston (1976).

Speight 1980
Speight, J.G., "The Chemistry and Technology of Petroleum", Marcel Dekker, Inc., New York (1980).

Stiver 1982
Stiver, W., "Studies of Crude Oil Evaporation", Bachelor of Applied Science Thesis, Department of Chemical Engineering and Applied Chemistry, University of Toronto (1982).

TSB 1984
Anonymous, "Manual for Spills of Hazardous Materials", Technical Services Branch, Environmental Protection Service, Environmental Canada, Cat No. Em40-320/1984E (1984).

Twardus 1980
Twardus, E. M., "A Study to Evaluate The Combustibility and Other Physical and Chemical Properties Of Aged Oils And Emulsions", Prepared for Research and Development Division, Environmental Emergency Branch, Environmental Impact Control Directorate, Environmental Protection Service, Environment Canada, Publication No. EE-5 (1980).

USCG 1971
Glaeser, J.L. & Vance, G.P., "A Study of The Behavior of Oil Spills in The Arctic", Office of Research and Development, U.S. Coast Guard (1971).

USCG 1972
McMinn, T. J., "Crude Oil Behavior on Arctic Winter", Ice, Environmental and Transportation Technology Division, U.S. Coast Guard (1972).

USEPA 1982
Anonymous, "Chemical Fate Test Guidelines", Office of Toxic Substances, Office of Pesticides and Toxic Substances, U.S. Environmental Protection Agency, Publication No. PB82-233008 (1982).

Yuen 1970
Yuen, K., "Report of The Task Force - Operation Oil (Clean-Up of The Arrow Oil Spill in Chedabucto Bay)", Vol. II, Minister of Transport, Info. Can. Cat. No. T22-2470/2 (1970).

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Note: These are the procedures being followed at Environmental Emergencies Technology Division, Environment Canada, and are referred to as (EETD) in the data sections.

APPENDIX A

1.0 PROCEDURE FOR USING DIGITAL DENSITY METER

1.1 INTRODUCTION

The following procedure is specific for Anton Paar Calculating Digital Density Meter Model DMA 45.

1.2 PROCEDURE

- Set test temperature on attached recirculating temperature control bath. Turn on temperature control bath.

- Turn "Power" switch of the Density Meter on. Follow calibration procedure if changing to a new test temperature.

- Rinse test cell with hexane. Turn air pump on and blow dry test cell. Wait about five minuter, turn air pump off and take air density reading. If air density reading is more than +/- 0.0002 g/mL from the literature density, recalibration the Density Meter.

- Fill plastic syringe with oil sample. Turn light on. Carefully insert syringe into the lower opening of the test cell and add oil to the test cell until the oil sample reaches the larger portion of the upper arm. Remove syringe. Seal the top sample opening with teflon plug. Do not apply lateral force on the sample opening.

- Inspect that there are no air bubbles in the narrow section of the test cell. Turn light off. Wait about five minutes and record density reading.

- Turn light on. Insert syringe into the lower sample opening and withdraw oil sample from the test cell. Rinse the test cell with hexane two or three times. Turn light off. Turn air blower on to blow dry the test cell.

- Take air density reading. If measured value is more than +/- 0.0002 g/mL from the literature value, rinse test cell with hexane, blow dry test cell and obtain another air density reading. Repeat rainsing or recalibrate density meter if measured air density is more that +/- 0.0002 g/mL from the literature value.

- Obtain another oil sample density as above and report the average value. If the two density measurements do not agree to within +/- 0.0002 g/mL, obtain another oil sample.

APPENDIX A

1.0 PROCEDURE FOR USING DIGITAL DENSITY METER (Con't)

1.3 CALIBRATION

- Turn on recirculating water bath and density meter as above. Set the readout of the density meter to "Period of Oscillation" (T) mode.

- Obtain the period of oscillaion of air (Tair). Add deionized water to the test cell and obtain period of oscillation of water (Twater). Remove water from test cell and blow dry test cell. Obtain period of oscillation of air again.

- Calculate density meter constants A and B (at the calibration temperature):

$$A = \frac{\text{Twater**2 - Tair**2}}{\text{density of water - density of air}}$$

$$B = \text{Tair**2 - A * density of air}$$

- Set the constants A and B on the constants storage switches (on top of the density meter).

- Set the readout to desnity mode. Obtain density readings of air and water. Recalibrate if the readings are more than +/- 0.0002 g/mL from the literature values.

2.0 PROCEDURE FOR VISCOSITY DETERMINATION USING ZEITFUCHS CROSS-ARM VISCOMETER

2.1 Introduction

The kinematic viscosity of crude oils and oil products is determined (assuming a Newtonian fluid) by measuring the time required for a known volume of oil to flow under gravity through a calibrated Zeitfuchs Cross-arm capillary viscometer at a specified temperature. This procedure is similar to ASTM D 445.

2.2 Procedure

- Estimate viscosity of oil sample and select calibrated Zeitfuchs Cross-arm viscometer with suitable viscosity range.

- Rinse viscometer with methylene chloride and let dry.

- Add oil sample to mark on the neck of viscometer.

- Place parafilm on both openings of viscometer.

- Place viscometer in 500 ml graduated cylinder filled with water (kept at test temperature).

- Oil sample should be more than 20 mm below water surface and the bottom of the viscometer should be more than 20 mm above the bottom of the graduated cylinder.

- Allow oil sample to reach the test temperature.

- Use pressure to force oil to start flowing down the vertical section of the viscometer.

- Measure flow time in seconds for the oil meniscus to pass from the first timing mark to the second timing mark.

- Flow time should be within 200 to 1000 seconds. Otherwise, calculate approximate viscosity and choose another viscometer to repeat the experiment.

- Clean viscometer with methylene chloride and repeat experiment at the same conditions (using the same viscometer).

2.0 PROCEDURE FOR VISCOSITY DETERMINATION USING ZEITFUCHS CROSS-ARM VISCOMETER (Cont'd)

- Periodically, inspect the viscometer and remove any deposits from the inside.

2.3 Calculations

To calculate kinema[illegible] viscosity, average the flow times from the two runs and obtain calibration constant of the viscometer:

Kinematic Viscosity (mm sq/s or cSt) = Average Flow Time (s) * Calibration Constant (mm sq/s sq or cSt/s)

To calculate dynamic vicosity:

Dynamic Viscosity (mPa.s or cp) = Kinematic Viscosity (mm sq/s or cSt) * Density (g/ml)

3.0 PROCEDURE FOR VISCOSITY DETERMINATION USING BROOKFIELD VISCOMETER

3.1 Introduction

The viscosity of non-Newtonian crude oils and oil products can be measured by a Brookfield viscometer. By rotating a spindle in a sample at a constant rate, the torque required to maintain a constant spindle rotation is displayed on the viscometer dial.This reading can be converted into dynamic viscosity.

3.2 Procedure

- Estimate viscosity of oil sample and select appropriate spindle.

- Rinse spindle and small sample holder with methylene chloride and let dry.

- Insert spindle inside sample holder. Use transfer pipette to add oil SLOWLY to the sample holder and place parafilm on sample holder opening.

- Allow sample, sample holder and spindle to come to test temperature in temperature control room.

- Insert sample holder to the sample holder jacket (from the bottom) and lock sample holder in place.

- Attach extension link to spindle.

- Lift shaft of viscometer slightly and thread coupling nut into place CAREFULLY. Do not move shaft sideways.

- Depress clutch and turn on viscometer. Release clutch. The rpm should be at 0.3. Turn speed to 0.3 rpm if required (when the spindle is rotating).

- Wait for spindle to rotate twice and note dial reading. You may have to depress cluch.

- If dial reading is below 10, turn rpm one step higher (when the spindle is turning). Wait for spindle to rotate twice and note dial reading.

3.0 PROCEDURE FOR VISCOSITY DETERMINATION USING BROOKFIELD VISCOMETER (Cont'd)

- Increase rpm one more step if dial reading is still below 10. Otherwise, record dial reading and rpm. Turn off viscometer.

- Lift shaft of viscometer slightly and unthread coupling nut.

- Remove extension link. Put parafilm on sample holder. Store sample at test temperature for a few hours. Remove parafilm and repeat measurement at the same rpm.

- Repeat measurement at this rpm once more.

- Rinse sample holder and spindle with methylene chloride.

3.3 Calculations

Average the last two dial readings. Obtain spindle factors from Brookfield Viscometer manual and calculate:

Dynamic viscosity = dial reading * spindle factor (cp or mPa.s)

4.0 PROCEDURE FOR INTERFACIAL TENSIONS

4.1 Introduction

The interfacial tension for the air-oil, oil-deionized water and oil-artificial seawater interfaces are determined using a Fisher Surface Tensiomat Model 21. The interfacial tensions are used for oil spreading tedency studies. This procedure is similar to ASTM D 56.

4.2 Procedure

4.2.1 Cleaning

Glassware: Wash with detergent and water. Rinse with dilute nitric acid and deionized water.

Platinum-iridium Ring: BE CAREFUL NOT TO BEND ANY PART OF THE RING. Rinse with methylene chloride and dry in fume hood.

4.2.2 Air-oil Interfacial Tension

- Keep oil sample and 100 ml beakers at test temperature for two to three hours.

- Pour about 40 ml oil into beaker and immerse ring into oil sample.

- Place beaker on platform of Tensiomat and attach ring to hook of Tensiomat.

- Adjust ring with knob on the right hand side of the tensiometer and adjust level of platform until the torsion arm is horizontal (using the mirror) and the ring is about 4 mm below the oil surface.

- Turn the knob on the front of the tensiometer until the vernier reads zero on the OUTER scale.

- Turn the knob on the right side of the tensiometer and lower the platform at the same time while keeping the torsion arm horizontal until the ring breaks from the interface.

- Record APPARENT surface tension.

- Oil sample is saved for the next section of the experiment (interfacial tension).

4.0 PROCEDURE FOR INTERFACIAL TENSION (Cont'd)

4.2.3 Oil-deionized water Interfacial Tension

- Keep oil, deionized water and 100 ml beaker at test temperature for two to three hours.

- Pour 40 ml of deionized water into beaker and place ring into deionized water.

- Put beaker on platform of Tensiomat. Arrest torsion arm and hook ring on the torsion arm.

- Tilt beaker and add about 30 ml of oil (which should be at the test temperature) slowly and carefully. Make sure the cross bar of the ring is above the oil surface and the ring is underneath the oil-water interface.

- Allow the interface to age for about 30 seconds.

- Adjust with knob on the right hand side of the tensiometer and adjust platform level until the torsion arm is horizontal and the ring is about 4 mm below the oil-water interface.

- Turn the knob on the front of the Tensiomat until the vernier reads zero on the OUTER scale.

- Turn the knob on the left side of the Tensiomat and lower the platform at the same time while keeping the torsion arm horizontal until the ring breaks from the interface. This should take about 30 seconds.

- Record APPARENT interfacial tension.

4.2.4 Oil-artificial seawater Interfacial Tension

Procedure is similar to the procedure for oil-deionized water interfacial tensions. Use filtered artificial seawater (40 g/l of Marinemix in deionized water) instead of deionized water.

4.0 PROCEDURE FOR INTERFACIAL TENSIONS (Cont'd)

4.3 Calculations

Calculate:

$$X = P/(D-d)$$

where: P = apparent interfacial tension (dynes/cm)
D = density of the lower phase (g/ml)
d = density of upper phase (g/ml)

Obtain correction factor for a given X from correction factor versus X curve.

Calculate absolute interfacial tension:

$$\text{Absolute surface tension (dynes/cm or mN/m)} = \text{Apparent surface tension (dynes/cm or mN/m)} * \text{Correction factor}$$

The density of water is 0.9998 g/mL and 0.9991 g/mL at 0 deg C and 15 deg C, respectively. The density of air is 0.0013 g/mL and 0.0012 g/mL at 0 deg C and 15 deg C (760 mm Hg), respectively. (Instruction Manual for Calculating Digital Density Meter, Anton Paar)

APPENDIX A

5.0 PROCEDURE FOR POUR POINT DETERMINATION

5.1 Introduction

Pour point is the lowest temperature, expressed as multiples of 3 deg C at which the oil sample is observed to flow when cooled and examined under prescribed conditions. This procedure is modified from ASTM D 97.

5.2 Procedure

5.2.1 Oil Sample Preparation

- Shake oil sample two to three times or until the sample is uniform. If oil is not fluid, heat oil in water bath until oil is very fluid.

- Pour oil into test jar until the level mark is reached.

- Make sure high pour point thermometer does not have a separated mercury column.

- Clean thermometer and fit stopper with thermometer tightly on the test jar.

- Adjust thermometer until oil level is about 1 cm above the end of the thermometer bulb, and thermometer should be coaxial with test jar.

- Insert test jar into pour point jacket. Make sure that test jar is vertical and secure. The following procedure will refer to the test jar and jacket conveniently as test jar.

5.2.2 Approximate Pour Point

- Heat test jar containing the oil sample and thermometer in water bath (at 48 deg C) until oil is very fluid. Use temperature bath at a higher temperature as required. Mix oil slightly.

5.0 PROCEDURE FOR POUR POINT DETERMINATION (Cont'd)

- Cool oil at room temperature. Tilt test jar just enough to notice any oil movement. If oil moves, allow oil to cool three deg C and test again. If oil does not move, continue to tilt test jar until test jar is horizontal. If oil moves during this time, allow oil to cool another 3 deg C and repeat. If oil does not move for 5 seconds at a horizontal position, record temperature as approximate pour point and proceed to the next section (this is referred to as a tilt test).

- When oil temperature is below 35 deg C and the oil still moves, continue cooling of the oil sample in the following sequence and perform tilt test every 3 deg C until approximate pour point is reached:

  a) cool oil sample to 25 deg C in 15 deg C room
  b) cool oil sample to 10 deg C in 0 deg C room
  c) cool oil sample to 0 deg C in freezer (about -10 deg C)
  d) cool oil sample to -34 in dry ice/acetone bath

Note that the low pour point thermometer is required when the oil temperature is below -12 deg C. Report approximate pour point of <-34 deg C if the oil sample still moves at -34 deg C and proceed to the next section.

5.2.3 Pour Point Above 32 Deg C

If the approximate pour point is above 32 deg C, follow the following procedure to determine the pour point:

- Heat oil sample in a test jar (fitted with a high pour point thermometer) in water bath (at 48 deg C) until oil is very fluid. Use temperature bath at a higher temperature as required. Mix oil slightly.

- Cool oil at room temperature until 8 deg C above the approximate pour point. Perform tilt test as in the previous section. Record the oil temperature when the oil sample does not move at a horizontal position for 5 seconds.

5.2.4 Pour Point Between 32 and -34 deg C

If the approximate pour point is between 32 and -34 deg C, follow the following procedure:

5.0 PROCEDURE FOR POUR POINT DETERMINATION (Cont'd)

- Heat oil sample in test jar (fitted with a high pour point thermometer) in water bath (at 48 deg C) until oil sample is very fluid.

- Cool oil sample in the following sequence until 8 deg C above the approximate pour point, and perform tilt test as in the previous section until the oil sample does not move in a horizontal position for 5 seconds:

a) cool oil sample to 35 deg C at room temperature
b) cool oil sample to 25 deg C in 15 deg C room
c) cool oil sample to 10 deg C in 0 deg C room
d) cool oil sample to 0 deg C in freezer (about -10 deg C)
e) cool oil sample to -34 deg C in dry ice/ acetone bath

Note that the low pour point thermometer is required when the oil temperature is below -12 deg C. Report oil temperature of <-34 deg C if oil sample still moves at -34 deg C.

NOTE: In sections 5.2.3 and 5.2.4, do not disturb the oil mass unnecessary. Repeat if thermometer or the oil mass shifted during tilt test.

5.3 Calculation

Add 3 deg C to results from sections 5.2.3 and 5.2.4, and report as pour point ASTM D 97.

APPENDIX A

6.0 PROCEDURE FOR FLASH POINT DETERMINATION

6.1 Introduction

Flash point is the lowest temperature of an oil sample, corrected to 101.3 kPa, at which application of a test flame causes the vapour of the sample to ignite under specific conditions of the test. This procedure is taken from ASTM D 93 for a Pensky-Martens Closed Tester.

6.2 Procedure

6.2.1 Approximate Flash Point

- Rinse sample cup with methylene chloride and let methylene chloride evaporate in the fume hood.

- Mix oil sample until oil is uniform and pour oil into sample cup until the filling mark is reached.

- Cool oil sample and sample cup to about 30 deg C below the estimated flash point.

- Assemble flash point apparatus.

- TURN FUME HOOD OFF.

- Light test flame and adjust flame to 4 mm in diameter (using metal bead on the sample cover).

- Start stirring and turn heater on.

- Adjust heating such that temperature rise is 5 to 6 deg C per minute.

- Lower test flame into the vapour space within about 0.5 seconds, leave test flame in the vapour space for 1.0 second and raise test flame to up position quickly. Repeat at every degree C temperature increase until flashing or 110 deg C (report approximate flash point of 110 deg C).

- The sample is deemed to have flashed when a large flame appears and instantaneously propagates over the surface of the sample. Record the temperature as approximate flash point.

- Turn test flame, heater and stirrer off.

- TURN ON FUME HOOD.

APPENDIX A

6.0 PROCEDURE FOR FLASH POINT DETERMINATION (Cont'd)

- Dissemble flash point apparatus.

- Take sample cup out of flash point apparatus (the apparatus is hot).

- When oil sample is cooled to about room temperature, pour oil sample into chlorinated solvent waste bottle. Rinse sample cup with methylene chloride and let it evaporate in the fume hood.

6.2.2 FLASH POINT

- Mix oil sample and pour it into the sample cup until the filling mark is reached.

- Cool oil sample and sample cup to about 30 deg C below the approximate flash point.

- Assemble flash point apparatus.

- TURN OFF FUME HOOD.

- Light test flame and adjust flame to 4 mm in diameter.

- Start stirring and turn heater on.

- Adjust heating such that temperature rise is 5 to 6 deg C per minute.

- When oil temperature is within 17 to 28 deg C below the approximate flash point, lower test flame into the vapour space in about 0.5 seconds, leave test flame in the vapour space for 1.0 second and raise test flame to up position quickly. Observe any flame in the vapour space. The sample is deemed to have flashed when a large flame appears and instantaneously propagates over the surface of the sample. Record this temperature as observed flash point and stop experiment.

- If flash point is not observed lower test flame as above at every deg C temperature increase.

- Stop when temperature is above 110 deg C and report observed flash point as >110 deg C.

- Turn off test flame, heater and stirrer.

APPENDIX A

6.0 PROCEDURE FOR FLASH POINT DETERMINATION (Cont'd)

- TURN ON FUME HOOD.

- Dissemble flash point apparatus.

- Take sample cup out of flash point apparatus (the apparatus is hot).

- When oil sample is cooled to about room temperature, pour oil sample into chlorinated solvent waste bottle. Rinse sample cup with methylene chloride and let it evaporate in the fume hood.

- Record atmospheric pressure.

6.3 Calculations

Calculate flash point (at atmospheric pressure):

$$\text{flash point} = \begin{array}{l}\text{observed}\\ \text{flash}\\ \text{point}\end{array} + 0.033\,(760 - P)$$

where P is atmospheric pressure in mm Hg.

APPENDIX A

7.0 PROCEDURE FOR REID VAPOUR PRESSURE DETERMINATION

7.1 Introduction

This procedure covers the determination of Reid vapour pressure according to ASTM D 323.

7.2 Procedure

7.2.1 Preparation of Reid Vapour Pressure Bomb

- Rinse bomb with methylene chloride, and let dry in a fume hood.

- Keep bomb in temperature control room kept at 0 deg C.

7.2.2 Sample Handling and Transferring

- Store oil sample in 0 deg C room for about 2 hours before test. There should be about 700 mL of sample in the one litre sample bottle.

- Put teflon tape on all joints of the bomb.

- Put vapour pressure gauge (15 psi) on bomb.

- Open sample container once. Mix sample a few times and pour crude oil into sample chamber until overflow. Tap chamber to free any air bubbles.

- Attach sample chamber to air chamber.

- Record atmospheric pressure (P).

7.2.3 Reid Vapour Pressure Measurement

- Shake bomb vigorously and immerse the bomb in the 37.8 deg C (100 deg F) water bath. Observe any leaks on all the joints.

- Discard sample and repeat the experiment if leakage is observed.

- Place bomb on rack in the water bath.

7.0 PROCEDURE FOR REID VAPOUR PRESSURE DETERMINATION (Cont'd)

- After 30 minutes, tap the pressure gauge gently and record pressure.

- If the vapour pressure is above 12 psi, use pressure gauge with range of 10 to 26 psi. Similarly, use pressure gauge with range of 0 to 5 psi if the vapour pressure is below 4 psi.

- Every 10 minutes, remove bomb from water bath and shake, replace bomb in the water bath and record pressure until two consecutive readings are identical.

- Attach pressure gauge to a mercury manometer and a compressed air source. Apply pressure to the pressure gauge and the manometer until the pressure gauge reads the same pressure as the recorded pressure above. Record the manometer reading.

7.2.4 Cleaning

- Pour sample into used solvent container.

- Rinse bomb with methylene chloride and let dry in fume hood.

- Rinse pressure gauge several times with methylene chloride and let dry in fume hood.

7.3 Calculations

Calculate correction factor:

$$C = (-0.138 * (P - 0.09)) - 0.86$$

where: C is correction factor in psi
P is atmospheric pressure in psi

Calculate Reid vapour pressure:

$$\underset{(kPa)}{\text{Reid VP}} = (\underset{(psi)}{\text{manometer reading}} + \underset{(psi)}{C}) * 6.895$$

APPENDIX A

8.0 PROCEDURE FOR MODIFIED ASTM DISTILLATION

8.1 Introduction

The experimental procedure is similar to the standard ASTM distillation method (ASTM D 86). The only major difference is that the oil temperature instead of the vapour temperature is monitored. Distillation data are used to provide the weathering rate of crude oil in the environment.

8.2 Procedure

- Add stirring bar and about 15 ml of glass beads to a 500 ml distillation flask.

- Pour 200 ml of crude oil into the distillation flask.

- Assemble distillation equipment, put aluminum foil around distillation equipment and start cooling water flow.

- Make sure tip of the temperature probe is below oil surface during the experiment.

- Turn stirrer on as fast as possible (without oil splashing).

- Start heating slowly. Condensate should run down the condenser in a dropwise fashion.

- Record initial temperature when the first drop of condensate runs down the curve of the condenser receiver.

- Record temperature at every 2 ml of condensate collected. Stop distillation when oil sample starts to foam, or no more condensate can be collected, or when the oil temperature is above 300 deg C.

- Turn off heater and stirrer. Remove heater and wait for equipment to cool.

- Record atmospheric pressure.

- Cleanup when equipment is cool.

8.0 PROCEDURE FOR MODIFIED ASTM DISTILLATION (Cont'd)

8.3 Calculations

8.3.1 Atmospheric Pressure Correction

Calculate correction factor:

$$C = 0.00012\ (760 - P)\ (273 + t)$$

where: P = atmospheric pressure in mm Hg
t = thermometer reading in deg C

Add correction factor to thermometer reading and round off readings after decimal point.

8.3.2 Initial Boiling Point and Slope

Convert volume condensed to volume fraction distilled. Plot corrected boiling temperature versus fraction of oil distilled on linear coordinates. Draw a best fit straight line through the data points. Determine the initial boiling point and slope of the line.

APPENDIX A

9.0 PROCEDURE FOR WATER-IN-OIL EMULSION FORMATION TENDENCY AND STABILITY TEST

9.1 Introduction

This experiment provides information regarding water-in-oil emulsion formation tendency and stability (f initial and f final) for crude oils and oil products by rotating a mixture of oil sample and artificial seawater at 65 rpm in a closed container. The volume of oil, emulsion and water layers are determined by height measurements from which the fraction of oil in the emulsion (f) and water content in the emulsion are calculated. The emulsion formation tendency and stability are based on the measured fractions (f's) (Mackay 1982a).

9.2 Procedure

- Clean 500 ml Fleakers with soap. Rinse Fleakers with tap water, dilute nitric acid, tap water and deionized water.

- Pour about 300 ml of seawater at test temperature into Fleakers. Adjust the seawater height to 9 +/- 0.1 cm at test temperature.

- Add about 30 ml of crude oil at test temperature to Fleaker, and label Fleaker.

- Put plastic sheet on Fleaker mouth and put stopper on. Keep Fleakers at test temperature for 2 to 3 hours.

- Repeat with seven other oil samples.

- Adjust oil height to 1 +/- 0.1 cm.

- Put Fleakers on emulsion apparatus (at test temperature). Rotate Fleakers for one hour at 65 rpm. Keep Fleakers at a vertical position for half an hour and record the following data: total height (oil + emulsion + water); height of oil and emulsion; and height of oil.

- Repeat rotation, rest and reading three times.

- Keep Fleakers at vertical position for 24 hours and record the following: total height; height of oil and emulsion; and height of oil.

9.0 PROCEDURE FOR WATER-IN-OIL EMULSION FORMATION TENDENCY AND STABILITY TEST (Cont'd)

9.3 Calculations

9.3.1 To Calculate f initial

Since the cross-sectional area of Fleakers are uniform, the volume of the layers can be calculated based on the height of the layers.

The fraction of oil in the emulsion after one hour of rotation and half an hour of rest (f 1.5) is:

$$f\ 1.5 = \frac{\text{Initial Oil Height} - \text{Oil Height at 1.5 h}}{\text{Initial Oil Height}}$$

Similarly the fraction of oil in the emulsion at 3.0, 4.5, and 6.0 hours can be calculated. The fraction of oil in the emulsion at time zero (f initial) is obtained by plotting f versus time and extrapolating the curve to time zero.

9.3.2 To Calculate f final

The fraction of oil in the stable emulsion after 24 hours of resting is calculated similarly using the height of the oil at that time.

9.3.3 Water Content in Stable Emulsions

The water content in the stable emulsion is:

$$\text{Height of Oil in Emulsion} = \text{Initial Oil Height} - \text{Oil Height}$$

$$\text{Height of Emulsion} = \text{Height of Oil and Emulsion} - \text{Oil Height}$$

$$\text{Fraction of Water in Emulsion} = 1 - \frac{\text{Height of Oil in Emulsion}}{\text{Height of Emulsion}}$$

APPENDIX A

10.0 PROCEDURE FOR ARTIFICIAL WEATHERING OF CRUDE OILS AND OIL PRODUCTS USING GAS STRIPPING

10.1 Introduction

To simulate natural weathering of crude oils and oil products in the environment, an oil sample is stripped by a stream of air at a specified temperature. The air volume, oil weight and volume are monitored. The experimental results can be correlated to the environmental conditions via environmental exposure (Mackay 1983 b).

10.2 Procedure

- Clean gas stripper and pour oil sample to about 980 ml mark. Keep gas stripper at test temperature for 2 to 3 hours.

- Connect compressed air supply to the gas stripper and connect outlet of gas stripper to hydrocarbon absorbers (3M absorbent and activated charcoal).

- Level wet test meter and add de-ionized water to full mark.

- Record temperature, compressed air cylinder pressure, volume and weight of oil sample, air volume of wet test meter.

- Start air flow to the gas stripper. Air flow rate should be as high as possible but without splashing or oil mist carry over from the stripper.

- Stop air flow to the stripper at regular time intervals and record oil weight and volume, and volume of air on the wet test meter.

- Stop gas stripping when desired degree of weathering is achieved.

10.0 PROCEDURE FOR ARTIFICIAL WEATHERING OF CRUDE OILS AND OIL PRODUCTS USING GAS STRIPPING (Cont'd)

10.3 Calculations

Volume fraction weathered (Fv):

$$Fv = 1 - \frac{\text{Final Oil Volume}}{\text{Initial Oil Volume}}$$

Similarly for weight fraction weathered (Fw).

APPENDIX A

11.0 PROCEDURE FOR CHEMICAL DISPERSIBILITY TEST

11.1 Introduction

Comparative chemical dispersibility of crude oils with respect to Corexit 9527 is provided using the Mackay-Nadeau-Steelman (MNS) apparatus (Mackay 1980 b).

11.2 Procedure

- Add 6 liters of artificial seawater (40 g/L of Marinemix in deionized water) to test vessel at test temperature.

- Assemble the MNS apparatus.

- Turn powerstat for the blowers to 85% and wait for a stable wave to form in the test vessel. The wave height should be at least 6 cm. Adjust power to the blowers to the pre-determined level.

- Make sure the water temperature is within 1 deg C of thetest temperature and the air temperature is within 3 deg C of the test temperature.

- Add 10 ml of oil sample to the inside of the glass containment ring.

- Start stopwatch and add 0.50 mL of Corexit 9527 to the oil sample. Distribute the dispersant evenly on the oil sample.

- At 1.5 minutes, raise the glass containment ring and allow oil sample to disperse. Wave height should not be less than 3 cm. Otherwise, repeat experiment.

- At 11.0 minutes, start siphoning water sample into a waste container.

- At 11.5 minutes, collect 250 ml of sample in a volumetric flask.

- Stop blowers and clean up.

11.0 PROCEDURE FOR CHEMICAL DISPERSIBILITY TEST (Cont'd)

11.3 Analysis and Calculations

Extract sample with UV grade methylene chloride. Determine absorbance of methylene chloride. Compare absorbance with standards and calculate oil concentration in the sample.

Calculate the percentage of oil dispersed chemically:

$$\% \text{ Dispersed} =$$

$$\frac{\dfrac{\text{mg oil}}{\text{mL extract}} \times \dfrac{\text{mLs of extract}}{\text{mLs of water sample}} \times 6000 \text{ mLs of water}}{10 \text{ mLs of oil} \times \text{density g/mL of oil}} \times 100$$

12.0 PROCEDURE FOR NATURAL DISPERSIBILITY TEST

12.1 Introduction

Comparative natural dispersibility of crude oils is provided using the Mackay-Nadeau-Steelman (MNS) apparatus (Mackay 1980 b).

12.2 Procedure

- Add 6 liters of artificial seawater (40 g/L of Marinemix in deionized water) to test vessel at test temperature.

- Assemble the MNS apparatus.

- Turn powerstat for the blowers to 85% and wait for a stable wave to form in the test vessel. The wave height should be at least 6 cm. Adjust power to the blowers to the pre-determined level.

- Make sure the water temperature is within 1 deg C of thetest temperature and the air temperature is within 3 deg C of the test temperature.

- Add 10 ml of oil sample to the inside of the glass containment ring.

- Start stopwatch.

- At 1.5 minutes, raise the glass containment ring and allow oil sample to disperse. Wave height should not be less than 3 cm. Otherwise, repeat experiment.

- At 11.0 minutes, start siphoning water sample into a waste container.

- At 11.5 minutes, collect 250 ml of sample in a volumetric flask.

- Stop blowers and clean up.

12.0 PROCEDURE FOR CHEMICAL DISPERSIBILITY TEST (Cont'd)

12.3 Analysis and Calculations

Extract sample with UV grade methylene chloride. Determine absorbance of methylene chloride. Compare absorbance with standards and calculate oil concentration in the sample.

Calculate the percentage of oil dispersed naturally:

% Dispersed =

$$\frac{\dfrac{\text{mg oil}}{\text{mL extract}} \times \dfrac{\text{mLs of extract}}{\text{mLs of water sample}} \times 6000 \text{ mLs of water}}{10 \text{ mLs of oil} \times \text{density g/mL of oil}} \times 100$$